

RM  
359  
R313  
v. 14  
no. 2  
c. 1  
GERSTS

# RADIUM

EDITED BY  
CHARLES H. VIOL, PH. D.  
AND  
WILLIAM H. CAMERON, M. D.

---

VOL. XIV

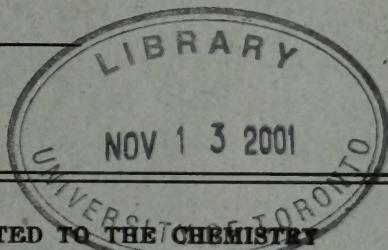
NOVEMBER, 1919

No. 2

---

## CONTENTS

The Treatment of Uterine Cancer by Radium.  
Henry H. Janeway, M. D. - - - - 17



---

A MONTHLY JOURNAL DEVOTED TO THE CHEMISTRY  
PHYSICS AND THERAPEUTICS OF RADIUM  
AND RADIO-ACTIVE SUBSTANCES



# RADIUM

A MONTHLY JOURNAL DEVOTED TO THE CHEMISTRY, PHYSICS AND THERAPEUTICS OF RADIUM AND RADIO-ACTIVE SUBSTANCES

Edited and Published by Charles H. Viol, Ph. D., and William H. Cameron, M. D.  
with the assistance of collaborators working in the fields of  
Radiochemistry, Radioactivity and Radiumtherapy.

Subscription \$2.50 per year, or 25 cents per copy in the United States and Canada  
in all other countries \$3.75 per year.

Address all communications to the Editors, Forbes and Meyran Avenues,  
Pittsburgh, Pa.

VOL. XIV

NOVEMBER, 1919

No. 2

## THE TREATMENT OF UTERINE CANCER BY RADIUM

By Henry H. Janeway, M. D.

Attending Surgeon and Head of the Radium Department  
Memorial Hospital, New York.

During recent years an increasingly conservative attitude in the treatment of cancer of the cervix uteri has been adopted in many of the large clinics. Cancer of the cervix uteri, as regards its amenability to surgical treatment, contrasts strongly with cancer of the fundus. The latter can be successfully removed in a large percentage of cases without exposing an otherwise normal individual to a serious risk, while the mortality after an adequately planned operation for cancer of the cervix is high and the percentage of cures disappointingly low.

During the last five years of the past century, the low percentage of cures produced by vaginal hysterectomy was generally recognized, and the extended abdominal operation adopted by the more important operators. Wertheim has earned the credit of perfecting the details of this operation, having published his description in 1898. His operation represents the widest removal of carcinoma of the cervix. In experienced hands it has given a generally considered high percentage of cures, based on a freedom from recurrence of 3 to 5 years.

The percentage of cures in any series of cases is, however, dependent upon the favorable character of the cases selected for the operation, and the radical nature of the operation to which the patient is exposed. Thus we find that the most favorable statistics of cures accompanies,

\*Reprinted from *Surgery, Gynecology and Obstetrics*, xxix, 242-265, September, 1919.

RADIUM

TABLE I.—PERMANENT RESULTS OF RADICAL

Name of Operator	Number Cases
Bumm .....	100
Hofmeier .....	..
Busse .....	75
Bayer .....	211
(Doederlein Clinic)	
Bovee .....	..
Taylor .....	40
Taussig .....	115
Collected from surgeons West of the Mississippi .....	..
Collected from Mayo Clinic .....	677
Schottlaender and Kermauner (Rosthorn Clinic) .....	..
Faure .....	..
Cullen (John Hopkins Hospital) .....	..
Neel (Dr. Kelly's Clinic) .....	263
Clark .....	..
Weibel (Wertheim's Clinic) .....	1430
Sampson .....	..
Krinski .....	736
Cobb .....	..
Waegeli .....	323
Wilson .....	59
Prochownick .....	536
Peterson .....	107

TABLE II.—RESULTS OF OPERA'

Name of Operator	Number Cases
Schauta .....	1305
Hofmeier .....	1909-1912
Waegeli .....	1913
Prochownick .....	..
Wilson .....	..

TABLE III.—COMPARISON WITH R

Name of Operator	Number Cases
Mayer .....	..
Taussig, from Mayo Clinic .....	..
Clark .....	..
Weibel, Wertheim Clinic .....	..
Waegeli .....	17
Prochownick .....	..
Peterson .....	17

as a general rule, a low percentage of operability and a high primary mortality. In 1911, Jacobson collected statistics on the operability, primary mortality, and curability, as judged by the five-year standard, in 2765 cases of uterine cancer, reported by 130 operators.

Twenty-eight operators recorded percentages of operability. These varied from 5 per cent to 90 per cent; seven less than 25 per cent., ten between 25 and 50 per cent, six over 75 per cent.

# RADeUM

19

## ABDOMINAL OPERATION FOR CANCER

Operability per cent	Operations	Mortality	Number Traced Cases. 3-5 Years	Cures
60	60	12 (20%)	48 (5 yrs.)	24 (5 yrs.)
78.95	90	18 (20%)	32 (5 yrs.)	10 (5 yrs.)
56	59	15 (25.4%)	59 (5 yrs.)	19 (5 yrs.)
68.70	118	24 (20.3%)	94 (5 yrs.)	34 (5 yrs.)
20	36	9 (23.3%)	23 (5 yrs.)	8 (5 yrs.)
	28	3 (10.7%)	4 (3-5 yrs.)	0
	12 (more favorable cases)	1 (8%)		
	11 (more advanced)	8 (72%)		
	37	9	12 (5 yrs. including his own cases.)	5 (5 yrs.)
37.8 (256 cases)	256	46 (18%)	12 (5 yrs.)	5 (5 yrs.)
	24	2	20 (5 yrs.)	4 (5 yrs.)
	49	11 (23%)	22 (3 yrs.)	14 (3 yrs.)
	136	28 (20.5%)	24 (2-5 yrs.)	6 (8-14 yrs.)
47.8	36	3 (8.33%)	54%	13 (19 mo. - 6 yrs.)
	675	113 (16.6%)	26 (5 yrs.)	7 (26.9% 5 yrs.)
	8		30 (3-5 yrs.)	14 (23% 5 yrs.)
18.4	109	14 (13%)	372	8 (26% 3-5 yrs.)
	34	5 (14.3%)	9% first 100 cases	160 (43% 5 yrs.)
26.81	37	13	30% in last 175 cases	
15	79	14 (17.7%)	8	
61	123	25	53	4 (50% 5 yrs.)
37.3	40	9 (22.5%)	6	11 (20.7% 3 yrs.)
			37	5 (83% 5 yrs.)
			23	7 (18.91% 5 yrs.)
			112	10 (43%)
			40	16 (14.2% 5 yrs.)
				18 (47.3%)

## TION BY VAGINAL ROUTE

Operability per cent	Operations	Mortality	Number Cases Traced. 3-5 Years	Cures
38.1	654	39 (9.8%) of 395 cases total mortality 7.6%	350	5 Year Result 133 (17.4%)
70.2 }	57	3 (5.26%)	50	18 (37.5%)
48.5 }	18	3 (16.66%)	18	3 (16.66%)
....	200	22 (11.11%)	178	22 (11.11%)
....	57	1 (1.75%)	51	16 (31%)

## RESULTS OF OPERATION ON FUNDUS

Operability per cent	Operations	Mortality	Number Traced Cases	Cures
69.97	26	2 (.76%)	24	5 (5 yrs.)
69.97	54	0 (0%)	54	54 (5 yrs.)
....	13	1 (7.7%)	13	7 (53.9%)
69.97	67	7 (10.5%)	....	4 to 6 yrs.)
76.47	13	2 (15.38%)	....	37 (51.2 to 60% 5 yrs.)
14.82	60	7 (11.6%)	....	5 (38.46% 5 yrs.)
	11	1 (11.1%)	....	31 (50.1%)
				9 (81.8%)

With some exceptions, a definite relation, was found to exist between the percentage of operability and the mortality rate.

The primary mortality of the 2765 operations was 19.45 per cent. The mortality of many operators was below this: in the case of Jacobs, 6.37 per cent; Zweifel, 10.8 per cent; Kline, 12.8 per cent; Wertheim, 10 per cent (last two hundred cases); Doederlein, 14.3 per cent.

Many of the operators could not report final results, and with sin-

gle exceptions there is no distinction between cancer of the fundus and cancer of the cervix. The following are the end-results reported:

Bergesio and Berrutti, of 20 patients operated on, 33 per cent were well one to four years afterwards.

Bumm, of 56 patients, 30 per cent were well one year and over.

Dobbert, of 11 patients, 35 per cent were well one to four years afterward.

Doederlein, of 15 cancers of the fundus, 72.7 per cent were cured according to Winter's standard, and of 32 cancers of the cervix, 26.9 per cent were cured (same standard).

Mackenrodt, of 144 patients, 61.5 per cent, or 74 per cent of the survivors from operation, were well one and a half to six and a half years afterward.

Pollossen, of 32 patients, 60 per cent were well five years later.

Reinecke, of 27 patients with cancer of the cervix, 20 survived the operation and 7, or 35 per cent, were well five years later.

In a subsequent report appearing in 1916, Jacobson includes more recent statistics and more definite information upon the permanent results of the radical abdominal operation for cancer of the cervix.

In the accompanying tables I have combined with these results with those of additional operators, some of which are still more recent.

A number of these authors have given statistics on the results of operation for cancer of the cervix by the vaginal route, Table II.

For comparison with the results of operation on carcinoma of the fundus of the uterus, Table III has been prepared.

A summary of these tables gives the following figures:

Carcinoma of the cervix removed by the radical abdominal operation: Of 5027 cases, 1720 or 34.21 per cent were operable. Of 1997 cases there was a mortality of 364, or 18.23 per cent. Of 1090 cases there were 386 cures (with few exceptions 5 years' standing) or 35.41 per cent of traced cases or 19.32 per cent of cases operated on, or less than 11.72 per cent of cases applying for treatment.

Carcinoma of the cervix removed by the vaginal method: Of 1305 cases, 654 or 58.1 per cent were operable (Schauta). Of 727 cases there was a mortality of 68 or 9.35 per cent. Of 647 cases, there were 192 cures (5 years' standing) or 29.67 per cent of traced cases or 17.74 per cent of cases operated on, or less than 11.72 per cent of cases applying for treatment.

Carcinoma of the fundus of the uterus: Operability, 76.47 to 97 per cent, average 86.73 per cent; mortality, 20 of 244 cases average 8.19 per cent; cures (5 years' standing) 148 of 242 operations, average 61.15 per cent or 53.03 per cent of cases applying for treatment.

If we accept Wertheim's conclusions that carcinoma of the cervix is twenty times as frequent as carcinoma of the fundus, it is possible to calculate on this basis the combined percentages for operability, mortality and curability of cancer of the uterus, i. e., including both cancer of the fundus and cancer of the cervix, by multiplying the percentages for carcinoma of the cervix by twenty, adding to the product the percentages for carcinoma of the fundus, and dividing by twenty-one.

Using this method the operability of carcinoma of the uterus is 37.61 per cent; the mortality is 17.74 per cent; the curability, based on the five-year standard for traced cases, is 36.63 per cent; for cases operated on, 21.31 per cent; for patients applying for treatment, 9.82 per cent.

A review of these tables indicates at first glance that the operative

statistics, more certainly in the case of cancer of the fundus, but even for cancer of the cervix, are not unfavorable to this method of treatment. When, however, certain facts are considered in connection with these figures, the operative treatment of cancer of the cervix is far from satisfactory.

In the first place, while the immediate mortality in the most skillful hands is only 10 per cent, it is still 20 per cent in skilled hands, and in the hands of even Wertheim, during the period of the development of his operation, in his first one hundred cases, it was 30 per cent.

Such a high mortality restricts the usefulness of the operation to relatively few surgeons, entirely inadequate to meet the demands of the large number of patients having cervical cancer. Nor does this high mortality tell the whole story. It leaves out of consideration entirely, first, the necessity for restricting the operation to a small percentage of the most favorable cases, and second, the suffering entailed by the operation itself and its sequelæ. Such sequelæ followed von Rosthorn's operations in no less than 42 per cent, and included ureteral and bladder fistulæ, secondary necrosis of the bladder, injury to the rectum, fistulæ of the intestine, and in one case a division of the obturator nerve with permanent paralysis of the leg. Weibel reports 6 per cent of ureterovaginal fistulæ from the Wertheim Clinic.

Postoperative sequelæ, including suppuration of the abdominal incision, cystitis, peritonitis, ureteral fistulæ, vesical fistulæ, phlebitis, laceration of the rectum, pleurisy and rectovaginal fistulæ occurred in 22 cases of Clark's 36 patients, or in 73 per cent.

The majority of these postoperative sequelæ are, of course, temporary, but a sufficient number are permanent to constitute a real objection to the operative treatment of cancer of the cervix. These various unfavorable complications of the operation, the high mortality after an operation which is at all adequate, the by no means infrequent and unpleasant postoperative sequelæ, and finally, after a woman has faced all these risks, not to mention the discomfort of the operation itself, the rather small prospect that she will be permanently cured, that she will not be obliged to suffer a lingering and painful death, has caused many of the most prominent gynecologists to adopt a more conservative attitude toward the radical abdominal operation for cancer of the cervix.

This attitude is expressed in the concluding sentence of Schottlaender and Kramauner's book: "The time is not yet ripe for a review and criticism of the literature, many co-workers are yet necessary. . . . At present we can only say that we do not wish to underestimate or overestimate the importance of the abdominal operation. We are still at the beginning of its development." At the time he wrote he considered it to be the only way to meet demands of the carcinomatous process.

Clark voices the same dissatisfaction with the operative treatment of cancer of the cervix. He states: "If an operation or other therapeutic procedure is to have a permanent place in our armamentarium it must be sufficiently easy to make it available, not for a few skilled specialists, but for the great body of surgeons working in every quarter of this and other countries. In these days of low mortality percentages, attending nearly all the major operations, no operation can possibly gain headway which combines with it a shockingly high mortality and a large number of distressing and disabling sequelæ.

"Further, while the continental surgeon, with his large and over-crowded clinics, may ignore the question of mortality in working out a principle, the American surgeon as well as the American layman is so

temperamentally constituted that the one cannot and the other will not disregard a high primary death rate. The effect upon the lay mind, therefore, must be taken into consideration, for while one may have over 50 per cent ultimate cures, the effect upon the average intelligent citizen is abhorrent, if for this number of survivors there have been twenty-five deaths and for the other twenty-five a wretched existence attended by repulsive postoperative sequelæ followed by a painful and lingering death. It is possible that when we make a final summary of our combined experience we may have to accept the conclusion that a less radical operation, even though it save fewer cases, may be preferable when attended by a low surgical mortality and few or no operative sequelæ."

Peterson, I believe, sounds the same note. He states: "Unfortunately added experience has strengthened my belief that the extended operation for cancer of the cervix is an exceedingly dangerous operation, always attended by a high primary mortality. No one will be more glad to discard the radical abdominal method than will I, if I can be shown that more patients can be ultimately saved by less dangerous methods."

Since the above quoted expressions about the radical abdominal operation were written, another method of treatment of cancer of the uterus, its treatment by radium, has become prominent.

Wickham can be properly referred to as the father of the radium treatment of cancer. He began his work in 1906 and published the results of the treatment of a thousand cases of cancer in 1910 and 1913. Also as a pioneer, and working with Wickham, must be mentioned Dominici, who is responsible for the development of many technical improvements, particularly in the principles of filtration. Following these men many isolated reports have appeared; especially may be mentioned those by Caan in 1909, and Czerny and Caan in 1912, and Pinch in 1912, by Riehl, Ranzi, Schueller and Sparmann in 1913; in this country, Abbe, and finally the book by Paul Lazarus in 1913. It is just to give to Kroenig the credit of the most important introduction of the use of radio-activity in gynecology, but while he may have done the pioneer work in gynecology, it was Doederlein's and Bumm's reports before the *Deutsche Gesellschaft fuer Gynaekologie*, at Halle, in May, 1913, and the papers by Cheron and Rubens-Duval, Schauta, Schindler, Scherer and Keley, and Latzko and Schueller, all in 1913, that furnished the great impetus to the treatment of cancer of the uterus by radium.

Doederlein reported one cure of an operable case of cancer of the cervix and excellent results in other cases. He presented microscopic sections proving the retrogression of cancer after the use of radium.

Bumm reported nine cases of apparent clinical cure of patients with advanced cancer of the cervix by the use of mesothorium and X-rays.

Cheron and Rubens-Duval reported 155 results, conservatively classified as improvements, of 158 patients with advanced cancer of the cervix. Forty-six of these improvements are probable cures. In two of the cases, both inoperable, the cure was proved, in one by autopsy, and in the other by histological section.

Schauta reported 11 clinical cures out of 16 patients with cancer of the cervix treated by radium and mesothorium. He believed that radium was the more effective of the two agents.

Schindler described some very favorable results in the treatment of cancer of the cervix by mesothorium and radium.

Scherer and Keley concluded that the treatment of 218 cases of cancer of the cervix by X-ray and radium gave 10.5 per cent greater freedom from recurrence than operation alone formerly gave.

Latzko and Schueller reported 5 clinical cures of 7 advanced cases of cancer of the uterus.

In the succeeding year still more encouraging results were published.

Bumm then recorded 108 cases of carcinoma of the cervix treated by radium. Of these only 5 were operable growths. Among them there were only 15 recurrences to date and a clinical cure had been produced in 10 inoperable growths.

Doederlein and von Seuffert obtained a disappearance of all subjective and objective symptoms in 31 of 153 cases of cancer of the uterus, and 12 of the 31 were inoperable.

Kroenig recorded 254 cases of cancer of the uterus treated by X-ray and mesothorium. Sixty-four were treated prophylactically after operation and 150 entirely without operation. Nineteen have undoubtedly remained free from cancer. He concluded that in cases in which cancer was still localized to its primary site, the type of case usually termed operable, he was able to cause the complete disappearance of the cancer as far as could be recognized histologically. His longest cure, however, had been under observation for only two years. He had never been able to cure metastatic carcinoma, nor in those cases in which the disease had invaded the neighboring tissues, deep invasion, for instance, of the broad ligaments, though remarkable retrogressions and temporary cessations of growth had followed the treatment of the latter.

Dobbert made, in many respects, the most important contribution in 1914. The results of the treatment of 44 cases of cancer of the uterus, of which 31 were cancers of the cervix, 18 inoperable and 6 operable, were so good that they justify him in concluding that it is permissible to treat early operable cancer of the cervix by radium alone. In many cases when the invasion of the tissues around the site of origin was deep, an elimination of the growth might be expected. In still more advanced cases a condition temporarily approaching a cure could be obtained. In the very advanced cases he discouraged treatment.

Weinbrenner described eight most successful results in the treatment of 32 cases of genital carcinoma by mesothorium.

Allman reported results on 85 patients with cancer of the uterus, treated with mesothorium. At the time of his report 15 of these patients were free from symptoms. These 15 patients either had recurrent growths or had refused operation. Twenty other inoperable cases became operable.

Legneu and Cheron reported a patient with an extensive, entirely inoperable, cancer of the vagina treated with radium, and two and a half years after the completion of the period of treatment, the patient died after an operation for another trouble. An autopsy was obtained and the complete absence of cancer demonstrated. Other confirmatory reports, but of less definite character, have appeared from Morton, Diefenbach, Foyeau de Cournelles, Jacobs, Kroemer, Tate, Pozzi and Rouhier, Certel, Seuffert and Klein.

In 1915 far more definite results were reported, many of which give information on the permanency of treatment by radium.

Doederlein now reports 12 patients with inoperable uterine cancer treated by radium and well at the time of his report, more than a year

## RADIUM

from the time the treatment was given. He definitely advocates the use of radiotherapy for operable uterine cancer.

Flatau states that since December, 1913, a period of one and a half years, he has not operated upon a single case of cancer of the cervix and has obtained a larger number of recoveries for an equal number of cases than he ever obtained by operation, though his mortality after operation was only 12 per cent.

Burrows reports that a disappearance of early cancer of the cervix and marked improvement in the more advanced lesions, after treatment by radium, is fairly constant.

Degrais reports a number of patients who had advanced cancer of the cervix treated by radium, who are in good health at the time of the report, four years after treatment.

Kelly and Burnam have made the most extensive use of radium in this country and have done so under very favorable conditions. They report the results on the treatment of 213 patients, 14 of whom were operable. Of these operable cases 4 were treated with radium alone and are all well, 2 for a period of two years and 2 for a period of one year after the treatment. The remaining 10 of the operable group were operated on first and afterward treated with radium. All were well at the time of the report at intervals of six months to three years after the treatment. The authors consider that these results are suggestive, when it is considered that after operation alone there is a recurrence in 75 per cent and in 60 per cent of the cases in the first year. One hundred and ninety-nine patients treated were inoperable at the time of the treatment; these included inoperable primary growths and inoperable recurrent cases. Fifty-three of this group are clinically cured and 109 markedly improved. Of 35 patients of this group, all primarily inoperable, 3 have remained well for four years, 2 for three years, and 17 for over one year. Eighteen primarily inoperable recurrent growths of this group are now clinically cured, 1 patient over six years, another over four years, 11 over two years, and 10 over one year.

In other words, 57 of 213 patients with cancer of the cervix, 4 operable and 53 inoperable, have been cured by radium; that is, all of the operable cases and 26 per cent of cases considered inoperable at the time of their treatment.

Baish reported that he has treated all cases of cancer of the uterus and vagina with mesothorium since February, 1914. At the time of his report he had treated 100 cases. The duration after treatment is from about twenty-one weeks to six months. He divides his patients into three groups. One group, 43 patients, were all inoperable, with definite parametrial infiltration. Many of these were benefited but only one clinically cured. In a second group of patients on the borderland of operability, 10, or 50 per cent, were clinically cured. The third group included 37 operable patients. Of these, 28, or 75 per cent, were clinically cured.

Adler reported a clinical cure in 9 inoperable cancers of the cervix, 2 inoperable cancers of the body of the uterus, and 1 of the vagina.

St. Clair recorded 2 cases in which radium was applied after incomplete operations for advanced cancer of the uterus. Fourteen months after the application in one case and a shorter interval in the other, both patients were, as far as could be ascertained, free from disease.

Fabre reported excellent results in 10 cases, the detailed histories of which were given.

Sir Thomas Oliver reported a very extensive recurrent cancer of the vagina apparently cured by a single application.

Von Graff, using the dosage recommended by Wertheim, and writing two years after a rather discouraging article by Wertheim on the radium treatment of uterine carcinoma, reported most encouraging results from the treatment of 102 cases of cancer of the uterus by radium. He concluded that radiumtherapy gives better results in the management of inoperable cases than any other method of treatment, and not a few cases thought inoperable have been so improved that the presence of carcinoma could no longer be demonstrated.

Miller also reported enthusiastically on the action of radium in advanced uterine cancer. He reported 6 cases, only one of which had gone one year from treatment. This patient presented, two years after operation, an extensive recurrence in the vault of the vagina. At the time of his report, one year after her treatment by radium, she was entirely free from symptoms.

Fueth and Ebeler reported results from the treatment of 56 patients with uterine cancer. Ten of these patients were operable and in each case retrogression had become complete, or nearly so, at the time of the report. Eleven other patients were treated prophylactically and six of the remaining number, all inoperable, were clinically cured. Other papers appearing in 1915, supporting the same conclusions, are by Bergonie and Speder, Abbe, Kolischer, Turner and Ranshoff.

Schmitz, in a paper appearing in 1916, recorded his results in the treatment of 80 cases of pelvic cancer. Of these he has obtained a clinical cure in 11 of 35 cases of inoperable cancer of the uterus, in 7 of 12 operable patients, and in 4 of 15 recurrent cases, making a total of 22 clinical cures of 62 patients, or 35.5 per cent. The post-treatment interval varied from four to twenty-four months. This report is very significant when we consider that 50 of his 62 patients, or 80 per cent, were not operable.

In the past year several important papers have appeared which more than confirm previous reports.

Maiolo has treated 50 patients, all of whom were inoperable or recurrent after hysterectomy. Eight of these patients were recently treated but of the remaining 42, 16 are anatomically and clinically cured for periods of one to two years.

Esquerido has treated 12 cases of uterine cancer; of these 3 were operable and all completely retrogressed. Of the remaining 7 inoperable patients, 3 were apparently cured.

Bailey reported 16 patients apparently free from disease, of 120 patients with uterine cancer treated with radium. Of these the post-treatment period had been two years in 1 case and one and a half years to two years in 4 cases, six months to one year in 8 cases, and one to six months in 3 cases.

Myers reported three excellent results, though recent, in 3 patients out of 5 whom he had treated. Labhardt, Klatz, and Heimann also reported favorable results.

Two other papers of particular importance have appeared during the past year.

The first of these is by Recasens, of Madrid. Recasens at first used radium only upon those cases which were too advanced for operation, or in which operation was contra-indicated, but his uniform success makes him no longer hesitate to treat early cancer of the cervix with radium. He states that if in inoperable cancer in which an actual

extension to the parametrium exists, so that the possibility of a cure by operation can no longer be entertained, one can obtain a cure by radium in 60 per cent of the cases, it is only logical to believe that in early circumscribed cancer of the cervix a cure by radium is more certain. He contrasts the gravity of the Wertheim operation, with its primary mortality of 10 to 15 per cent in the hands of the best surgeons and its secondary mortality after the lapse of three to five years of 40 to 50 per cent, with the comparatively safe and simple procedure of treatment by radium with its "100 per cent of cures" in this stage. His belief that 100 per cent of the early cases are cured by radium is based on the fact that every one of 16 such cases, which he has treated, has undergone a complete retrogression and a number of these have already completed three years since the treatment was applied.

In addition to these results in operable cancer he has treated 182 inoperable cancers of the cervix. Forty-seven of these were treated in the year 1914, and of these 29 were well at the time of the report. In 1915 he treated 79 patients, of which number 45 were well at the time of the report. He has not been so fortunate in cancer of the body of the uterus. Of 16 cases of cancer of the body, only 8 were clinically cured and 6 have died, 2 being still under treatment. He concludes that 70 per cent of his inoperable cancers and 95 per cent of those cases in which the growth was still limited to its site of origin have been cured by radium. Fifty per cent of his cases of cancer of the fundus have been cured, but in this group he prefers operation, unless the woman is fat or possesses some other contra-indication to operation.

A second paper of equal importance is by Clark. He reports 100 patients with genital carcinoma treated by radium. Seventy-four of these were carcinoma of the cervix and 4 of the fundus. Fifty-five of these patients were alive and free from symptoms, two to thirty months after treatment, and in the case of 5 patients twenty-two to thirty months after treatment.

My own cases are few in number, being limited to patients referred to me for personal care. The majority of them are, from the standpoint of operability, border-line cases. They are in consequence important from the standpoint of radiumtherapy, and I wish to put them on record, first, because I believe that the results obtained in them illustrate what can be obtained by the use of radium, in place of operation, in early cancer of the cervix, a preference in treatment, which is shared at present by very few surgeons; second, because I believe that there is an advantage in using the method of treatment which has been employed in these cases and which has been the outgrowth of my use of radium in other portions of the body.

#### CARCINOMA OF THE CERVIX—17 CASES, 12 CLINICALLY CURED TO DATE, 3 1/3 YEARS TO 6 MONTHS AFTER TREATMENT.

CASE I. Operable carcinoma of the cervix, clinically cured to date, 3 1/3 years after treatment M. F., Hosp. No. 23027, age 48. On admission on March 25, 1916, the cervix was found to be enlarged and its vaginal surface ulcerated. The ulceration surrounded the external os, but did not reach the vaginal walls. The margins and base of the ulcer were raised, hard, and nodular. The body of the uterus was not enlarged. Microscopical examination revealed plexiform epidermoid cervical carcinoma. The cells showed slight swelling, much nuclear hyperchromatism and homogenization of the nuclei. At some points there was a rich exudation of lymphocytes and polymorphonuclear leu-

cocytes which encroached on the masses of degenerating tumor cells. The patient's attention was first attracted to her disease by intermenstrual bleeding and rather profuse menstruation during the past two months.

*Treatment.* On March 25, 1916, 1 tube, containing 200 millicuries, in 1.5 millimeter rubber covered platinum, was left in the cervical canal for 16 hours; 2 tubes, containing 200 millicuries, in 1.5 millimeter rubber covered platinum, were left on vaginal surface of cervix for 16 hours. Examination on January 10, 1917, revealed no evidence of disease present. Examination May 6, 1918, showed absence of any evidence of disease. As the patient lived a long distance from New York, it was decided to give a prophylactic and mild treatment. One tube, containing 39.8 millicuries, in 1 millimeter rubber covered platinum, was placed in the vault of the vagina 6 hours.

Examination May 2, 1919, failed to discover any evidence of disease and a letter July 15, 1919, stated that the patient was in perfect health.

**CASE 2.** Carcinoma of the cervix uteri on the borderland of operability, clinically cured to date 3 years after treatment. J. H., Hosp. No. 23521, age 52.

On admission, July 31, 1916, the cervix was found to be considerably enlarged and very hard. The body of the uterus did not feel enlarged. Extending over the dorsal portion of the cervix, about half-way to the reflexion of the mucous membrane to the vaginal wall, was an ulceration with hard base. Microscopical examination revealed plexiform epidermoid carcinoma. The patient has never considered herself strong and has been very nervous since an attack of nervous prostration 18 years ago. She has had three children, and one miscarriage 29 years ago. The oldest child is 27, youngest 16. The births were normal. Her menses have always been regular, every 3½ weeks, of 5 to 6 days' duration, with profuse flow. From April 15, 1916, to June 30, there was no menstruation. Then she was in bed with an intermittent flow for two weeks. After being up one week, she started to flow again, and has had intermittent moderate flow ever since.

*Treatment.* On July 3, 1916, 3 tubes, containing together 300 millicuries, in 1 millimeter rubber covered platinum, were placed one in the cervical canal, two against the vaginal surface of the cervix, for 12 hours. On September 20, 1916, the ulceration on the outside of the cervix was almost healed. The cervix was diminished in size and the uterus freely movable. One week following treatment, the patient had a haemorrhage similar to the previous ones, the bleeding lasting one day. There was a gradual diminution of the discharge and there has been no discharge of blood since. At no time have there been any bladder or rectal symptoms. Her general health is steadily improving. Examined June 6, 1918, and found free from evidence of disease. Letter June 18, 1919, states that the patient is in perfect health.

**CASE 3.** Operable carcinoma of the cervix clinically cured to date, 10/12 years after one application of radium. M. F., Hosp. No. 24738, age 42. The patient has had good health. Ten years ago she was operated upon for tubal pregnancy. Eleven years ago she was curetted for a miscarriage. She has been married 25 years. She is the mother of one child by instrumental delivery. The patient applied for treatment September 5, 1917. Six months before this the menses became irregular. Three months ago there was profuse bleeding at frequent intervals. Examination shows the posterior lip of the cervix to be the seat

## RADIUM

of an ulcer 2 by 3 centimeters. The whole cervix is enlarged and hard. The uterus is movable and normal in size. There is no infiltration in the broad ligaments. Microscopical examination reveals epidermoid carcinoma.

*Treatment.* On September 5, 1917, 3 tubes, containing 123 millicuries, in 0.5 millimeter silver, were arranged end-to-end in the utero-cervical canal and left for 8 hours; also 3 tubes, containing 60 millicuries, in 0.5 millimeter silver, were applied against the cervix in dental modeling compound, for 8 hours. Healing followed in two months and the patient has been free from evidence of disease since.

Examined November, 1918, and found free from evidence of disease. Letter dated July 18, 1919, states that her health is perfect.

**CASE 4.** Operable carcinoma of the cervix clinically cured to date, 1½ years after one treatment by radium. B. R. H., Hosp. No. 25129, age 74. The patient has had good health aside from sciatica and tonsillitis. The menses appeared at the age of 11, were scanty and regular, lasting from 5 to 6 days. Last date of menstruation at 54. She has had three children between 56 and 34 years ago. Labors were rather difficult with slight tears. The patient applied for treatment January 16, 1918. Four years before this she developed a partial prolapse of the uterus. Two weeks ago she sought treatment for the prolapse and was advised to wear a pessary. This was inserted and at the time of insertion a small ulcer was found on the cervix. She had felt no pain nor noticed any discharge from this. Examination showed a small ulcer on the anterior lip of the cervix about 2 centimeters from the external os. The ulcer measured 2 by 1.25 centimeters and was 0.5 centimeter deep. No deep infiltration was present. Microscopical examination revealed epithelioma of the cervix.

*Treatment.* On January 16, 1918, 2 unfiltered minute glass tubes, containing 8 millicuries, were embedded in the base of the ulcer, their period of decay giving an exposure of 1056 millicurie hours. On June 30, 1918, there was no evidence of the disease and no induration. On February 12, 1919, the patient was examined and found free from evidence of disease. Letter dated July 20, 1919, states that she is free from uterine symptoms.

**CASE 5.** Inoperable carcinoma of cervix clinically cured to date, 14 months after the first application of radium. G. S., Hosp. No. 25431, age 34. The patient has enjoyed very good health and has never been ill until the present trouble. The menses have been regular and normal. She has two children 13 and 14 years of age. The births were difficult and no instruments were used. The patient applied for treatment May 1, 1918. Three or 4 months before she first noticed bleeding from the vagina. This gradually increased up to the present time. Her physician at first advised operation but after having her under observation for about four weeks referred her to us for treatment. Examination showed the anterior lip of the cervix completely replaced by a large fungating papillary mass 5 centimeters in diameter completely filling the vault of the vagina; it bled on slightest touch and involved the mucous membrane as far as the vaginal wall. The uterus was movable. Microscopical examination revealed papillary plexiform epithelioma.

*Treatment.* On May 1, 1918, 3 tubes, containing together 191.9 millicuries, in 1 millimeter platinum, were applied for 15 hours, the tubes being arranged end-to-end in a rubber tube, placed in the utero-cervical canal. On the same day, 7 unfiltered minute glass tubes, con-

taining together 19.1 millicuries, were embedded in the tumor mass, their period of decay giving an exposure of 2521 millicurie hours. Following the treatment there was a quick retrogression of the tumor mass and retrogression appeared to be complete on August 19, 1918. Examination June 1, 1919: no evidence of disease; letter July 20, 1919, patient in perfect health.

CASE 6. Borderland but probably operable carcinoma of the cervix clinically cured to date, 14 months after one application of radium. N. H. D., Hosp. No. 25459, age 53. The patient has previously had good health. She has two children; the first an instrumental difficult delivery. The menses have always been regular and normal. She applied for treatment May 10, 1918. In March, 1917, she noticed an intermenstrual flow which gradually grew worse. She was curetted in April, 1918. Examination showed the vaginal surface of the cervix to be normal. The uterus was movable though together with the cervix was enlarged one-third the normal size. Microscopical examination revealed basal-cell carcinoma beginning within the cervical canal.

*Treatment.* On May 11, 1918, 5 unfiltered minute glass tubes, containing together 21.2 millicuries, were embedded in the tissue of the cervix, the decay period of which gives a dosage of 2798 millicurie hours; also, 3 tubes, 156 millicuries, in 1 millimeter platinum, were applied for 20 hours, the tubes being arranged end-to-end in the uterocervical canal. Examination September 30, 1918, showed no evidence of the disease. Examination June 4, 1919, showed no evidence of disease and letter dated July 20, 1919, states the patient's health is perfect.

CASE 7. Inoperable carcinoma of the cervix, clinically cured to date, 13 months after one treatment by radium. S. L., Hosp. No. 25563, age 48. The patient had scarlet fever when a child. She has had three children and one miscarriage. The first child was born 25 years ago, instrumental, difficult labor. The second child was born 12 years later and the third ten years after that. The menses have been regular and normal and there has been no unnatural discharge. The patient's general health has always been good. She applied for treatment June 15, 1918. Two months ago menstruation did not occur at the regular time but a profuse and irregular bleeding from the vagina appeared. There was no pain, no constipation and no bladder trouble. Examination showed the posterior lip of the cervix enlarged to twice the normal size, and covering its surface was a papillary growth infiltrating the underlying tissue. There was no infiltration of the broad ligaments. Microscopical examination revealed epithelioma of the cervix.

*Treatment.* On June 15, 1918, 11 unfiltered minute glass tubes, containing together 22.5 millicuries, were embedded in the cervical mass, the decay period giving a dosage of 2969 millicurie hours; also 3 tubes, containing together 137 millicuries, in 1 millimeter platinum, were applied for 27 hours, the tubes being arranged end-to-end in a rubber tube placed in the uterocervical canal.

March 1, 1919. Absolutely free from all local or general evidence of disease. There is no ulceration on the cervix. The cervix and uterus are normal in size and freely movable. Examined June 19, 1919, and found free from any evidence of disease.

CASE 8. Operable carcinoma of the cervix clinically cured to date, 12 months after one application of radium. M. McC., Hosp. No. 25657, age 40. The patient had scarlet fever followed by oedema of the legs for a period when a child. Otherwise her health has been good. The menses have been regular and normal in amount. She has no

## RADIUM

children. The patient applied for treatment July 16, 1918. Three months ago the patient noticed during an attack of constipation, some bleeding in the interval between menses. The flow increased and lasted from one to three days. She felt no pain and no discharge between periods of haemorrhage. Examination showed the surface of the cervix to be destroyed by a hard rigid nodular ulcer. The ulcer extended posteriorly to the vaginal vault and bled easily. The uterus was normal in size although its movement was somewhat restricted. Definite induration in the broad ligaments could not be made out. Microscopical examination revealed epidermoid carcinoma.

*Treatment.* On July 16, 1918, 16 unfiltered minute glass tubes, containing together 29.2 millicuries, were embedded in the tumor mass, the period of decay giving a dosage of 3854 millicurie hours; also 3 tubes, containing together 100 millicuries, in 1 millimeter platinum, were applied for 20 hours, the tubes being arranged end-to-end in a rubber tube placed in the uterocervical canal. Examination May 29, 1919, showed no evidence of disease. Letter dated July 21, 1919, states that patient's health is perfect.

**CASE 9.** Inoperable carcinoma of the vagina, clinically cured to date, 11 months after one application of radium. C. H., Hosp. No. 25686, age 40. The patient has had infrequent epileptic attacks for 20 years. She had appendicitis last January. The menses have been painful. She has had four children; labors difficult. The patient applied for treatment July 25, 1918. Two years before she began to have slight haemorrhage from the vagina and pain in the right groin. She has had constant backache and frequent micturition. Examination showed the vaginal wall immediately adjacent to the right side of the cervix covered with a neoplastic mass consisting of 2 nodules, one 2 centimeters in diameter, and the other 1 centimeter in diameter. Microscopic examination showed epithelioma.

*Treatment.* On July 27, 1918, 11 unfiltered minute glass tubes, containing together 25 millicuries, were embedded in the tumor mass, their period of decay giving a dosage of 3300 millicurie hours; also 3 tubes, containing together 281 millicuries, in 1 millimeter platinum, were applied for 11 hours, the tubes being arranged end-to-end in a rubber tube and placed in the uterocervical canal. September 25, 1918, the ulceration was entirely healed. March 1, 1919, retrogression still appears to be complete. July 10, 1919, examined and found free from all evidence of disease.

**CASE 10.** As regards operability, a borderland carcinoma of the cervix, previously cauterized, clinically cured by an application of radium. Later recurrence in the retrovaginal septum apparently successfully treated by a second application. M. S., Hosp. No. 25939, age 46. The patient has always been in good health, with no previous illness. Her menses have been normal as to time and duration. She has had two children, 24 and 22 years of age. The first birth was instrumental, the second normal. The patient applied for treatment October 22, 1918. Four months ago she began to flow continuously and was examined in May, 1918. Cauterization of the neck of the womb was suggested but was postponed until August, when she was told that a cancer had formed. Two weeks following cauterization, haemorrhage appeared again and continued to the present time, with pain in the groin. Examination revealed the absence of the cervix, and in the center of the remaining portion of the canal an ulcerated area which did

not feel very hard. The uterus was movable. Microscopic examination showed recurrent carcinoma of the uterus.

*Treatment.* On October 23, 1918, 2 tubes, containing together 117 millicuries, in 1 millimeter platinum, were applied for 21.5 hours, the tubes being arranged end-to-end within a rubber tube, placed in the uterocervical canal. November 20, 1918, two nodules have developed in the posterior vaginal wall. November 20, 1918, 2 tubes, containing together 5 millicuries, without filtration, were embedded within the nodules in the posterior vaginal septum. December 26, 1918, the nodules have been replaced by a broad indurated ridge, and on this day, 4 unfiltered minute glass tubes, containing together 9.3 millicuries were embedded in the mass in the postvaginal septum, giving a dosage of 1227 millicurie hours. February 12, 1919, the induration in the postvaginal wall has not disappeared and a small rectovaginal fistula has developed. July 17, 1919, the induration in the rectovaginal septum has disappeared and the fistula has closed and no evidence of disease remains.

**CASE 11.** Inoperable carcinoma of the cervix, clinically cured to date, 9 months after one treatment by radium. L. F., Hosp. No. 25958, age 40. The patient's previous health has been fair though she has never been robust. The menses have been regular, but inclined to be a little profuse, lasting 6 to 7 days. She has two children, 16 and 3 years of age. When the first child was born instruments were used and the patient sustained a severe laceration in the cervix uteri which was never repaired. Digestion is sensitive and the bowels regular. The patient applied for treatment October 30, 1918. Last April she first noticed the pain in her back. There was no change in the menses until June, when menstruation became more profuse and appeared every two weeks. In September there occurred three severe haemorrhages 24 hours apart. Her symptoms became gradually worse to date. Examination showed that the whole cervix was destroyed by an ulcerated infiltrating growth which was covered on its surface with slough and neoplastic nodules. The infiltration extended to the anterior and posterior vaginal walls and into the broad ligaments so that the normal mobility of the uterus was greatly reduced. Microscopical examination revealed epidermoid carcinoma.

*Treatment.* On October 30, 1918, 6 unfiltered minute glass tubes, containing together 21 millicuries, were embedded in the cervix, their period of decay giving a dosage of 2772 millicurie hours; also 3 tubes, containing 142 millicuries, with 1 millimeter platinum, were applied for 18 hours, the tubes being arranged tandem fashion, in the uterocervical canal. On November 6, 1918, 1 tube of 44 millicuries, in 1 millimeter platinum, was applied for 12 hours, the tube being placed within the cavity of the uterus. January 31, 1919, examination showed complete healing of the ulceration except for a small nodule the size of a pea to the right and behind the external os. The induration had disappeared to a large degree so that the cervix was not much harder than normal. The infiltration in the broad ligaments was still present, though less, and the movement of the uterus was still somewhat restricted. March 7, 1919, there was an entire disappearance of ulceration and induration. There was no evidence on examination that any malignant tissue remained though the cervix was deformed and its mobility limited as a result of its destruction, by the newgrowth and the scarring following treatment.

**CASE 12.** Inoperable carcinoma of the vagina, clinically cured to date, 6 months after one application of radium. J. McC., Hosp. No.

26005, age 50. The patient had bladder trouble when 8 years of age, typhoid at 26 years. Menstruation had been normal. Eight years ago she began to have menorrhagia and metrorrhagia which persisted for a year until the patient took some local treatment which relieved her. On November 14, 1918, she applied for treatment. Five weeks ago she began to have pains throughout the lower abdomen, radiating down the thigh. Menstruation became scanty and an irregular and watery leucorrhœa, blood-tinged and offensive, developed. Examination showed the posterior right lateral and anterior vaginal walls to be covered with an ulcerated infiltrating mass covered by nodules which formed three rather well separated discrete masses. The total area of the mass was 6 by 9 centimeters. No glands were palpable in the groin. Microscopical examination showed epidermoid carcinoma of the vagina.

*Treatment.* On November 16, 1918, 8 unfiltered minute glass tubes, containing together 23 millicuries, were embedded in the tumor mass, giving a dosage of 3036 millicurie hours. On December 24, 1918, the entire lesion had disappeared except for a small fibrotic nodule in the posterior wall of the vagina just behind the introitus.

May 1, 1919, free from evidence of disease.

CASE 13. Inoperable carcinoma of the vagina and cervix improved for 8 months by one treatment of radium; subsequent applications ineffective. W. C., Hosp. No. 24452, age 56, had always had good health. The menses were regular and normal. She has had several children and three miscarriages. There were lacerations when the first child was born and ever since she has had a severe prolapse of the uterus. The patient applied for treatment May 28, 1917. About one year before this she began to feel pain in the left lower quadrant of the abdomen. It has increased in severity during the past four months and has been accompanied with a slight flow. Her general health has deteriorated. She has lost 30 pounds in the past year. Examination discloses an indurated ulcer covering an area of 6 square centimeters in the vault of the vagina and involving the cervix. Microscopical examination reveals papillary plexiform epidermoid carcinoma.

*Treatment.* On May 28, 1917, 4 tubes, containing together 37 millicuries, filtered through 0.5 millimeters silver, applied for 12 hours against surface of ulcer, in dental modeling compound. On October 1, 1917, there was no evidence of the disease. On March 19, 1918, a small recurrent ulcer was found in the vault of the vagina and 3 tubes, containing together 12.4 millicuries, without filtration, were embedded in the ulcer.

Following this treatment local improvement was reported, but the patient failed to return for observation until September 27, 1918, when an extension of the disease was observed. On October 1, 1918, 6 tubes, containing together 20 millicuries, without filtration, were embedded in the ulcerated area.

On March 1, 1919, a urinary fistula developed and around it an ulcer 3 centimeters in diameter, with indurated base and edges and considerable deep infiltration of the underlying tissue, characteristic of neoplastic tissue.

The poor result in this case is attributed probably to the inaccuracy and small dose of the first application, which in turn depended upon the extreme mobility of the uterus and looseness of the vaginal walls.

A better result would have probably followed the embedding of emanation tubes in the ulcer.

**CASE 14.** Extensive carcinoma of the vagina temporarily improved by surface application of radium; recurrence in 4 months and gradual deterioration of the patient's condition. E. C., Hosp. No. 24467, age 60 years. Except for a severe attack of pneumonia two years ago, the patient's health has always been good. The menses were regular and normal. She has had nine children. The menopause occurred at the age of 40. The patient applied for treatment June 4, 1917. Two years before this she noticed a slight yellow discharge, and since that time she has lost 10 pounds in weight and has gradually lost her strength, and the discharge has increased in amount. Examination shows that the whole anterior wall of the vagina and adjacent portion of the cervix is the seat of an indurated growth, the surface of which is covered by small neoplastic nodules. Microscopical examination reveals carcinoma of the vagina.

*Treatment.* On June 4, 1917, 24 tubes, containing together 360 millicuries, in 0.5 millimeter silver, were applied over the surface of the ulcer in dental modeling compound, for one hour. On July 17, 1917, the lesion was found to be reduced to one-half the original size. On the same day, 6 tubes, containing 198 millicuries, in 1 millimeter platinum, were applied over the surface of the ulcer in dental modeling compound for 4 hours. On August 17, 1917, retrogression seemed to be complete. On October 4, 1918, a fresh ulceration appeared on the anterior lip of the cervix, and on October 7, 1918, 3 tubes, containing together 256 millicuries, in 1 millimeter platinum, were applied for 11 $\frac{3}{4}$  hours in the uterocervical canal.

Following this treatment a uterovaginal or vesicovaginal fistula developed although continued retrogression of the disease took place. Her general health gradually deteriorated and the presence of internal metastases was feared. Report on March 11, 1919, states that she has not had any bleeding in the last 4 weeks. The urinary fistula is still present and she is very weak, but during the past 5 or 6 days she has been gaining in strength.

**CASE 15.** Inoperable carcinoma of the cervix clinically healed for almost a year by one application of radium; recurrence incompletely controlled by a second treatment. J. B., Hosp. No. 24695, age 44. The patient's previous health has been good. She has had two children, one miscarriage induced by instruments at 3 months, followed by infection which confined her to bed for 2 months. The patient applied for treatment August 15, 1917. Last November (1916) menstruation became profuse without pain. In March, 1917, an intermenstrual bleeding developed and soon became nearly constant and continued to time of applying for treatment, with perhaps a week's intermission, now and then, and still without pain. For the previous few weeks, an offensive leucorrhœa has been present and the bleeding has become less profuse. She has lost much strength and some flesh. Examination shows that the whole of the vaginal surface of the cervix is destroyed by an ulcerated growth, the surface of which is covered with numerous neoplastic papillary projections. The uterus itself is not much enlarged and its normal mobility does not appear to be restricted. Microscopical examination reveals carcinoma of the cervix.

*Treatment.* On August 16, 1917, 2 tubes, containing together 140 millicuries, in 1 millimeter platinum, were applied in a rubber covered tube in the cervix for 2 hours; also 13 tubes, containing together 325

## RADIUM

millicuries filtered through 0.5 millimeter silver, were applied in dental modeling compound against the cervix, for 12 hours. On November 5, 1917, there was found on the anterior lip of the cervix a hard dense nodule, but no definite evidence of neoplastic tissue was present (ulceration healed). December 17, 1917, showed the cervix still healed. The patient complained of painful defæcation. Examination revealed induration in the rectovaginal septum and some thickening of the broad ligaments. April 11, 1918, examination showed that the thickening of the rectovaginal septum had increased, producing stenosis of the rectum. On August 12, 1918, 8 unfiltered minute glass tubes, containing together 16 millicuries, were embedded in the mass in the rectovaginal septum, giving a dosage of 2112 millicurie hours. Following this treatment a rectovaginal fistula developed. To relieve this and the pain in the rectum, due to the recurrence, a colostomy was performed on September 25, 1918. This afforded the patient much relief from pain, but the infiltration of the tissues in the vault of the vagina remained and the patient's general condition steadily deteriorated.

June, 1919. During the past few months a remarkable improvement in the whole condition of the patient has developed; she left her bed, came to the office and was examined. Considerable diffuse induration still remained in the vault of the vagina, but the patient's general condition aside from the presence of pain and edema of the legs was good.

**CASE 16.** Inoperable carcinoma of the cervix, clinically improved for 9 months after one application of radium. K. J. K., Hosp. No. 25551, age 54. The patient has enjoyed good health. Menstruation has been normal as to regularity and duration. She has had 8 children. One child is said to have weighed 20 pounds. This delivery was difficult and the cervix was torn. The patient applied for treatment on June 11, 1918. She menopause had occurred five years before. Seven months ago the patient noticed an irregularly appearing discharge from the uterus which 2 or 3 weeks ago became bloody. She has had slight backache for years, but she felt well and strong, and has had a good appetite and her bowels were regular. Examination showed extending laterally to the right from the cervical canal a deep ulcer with elevated nodules. The lesion was hard. The uterus was not enlarged and was movable. There was no induration of the broad ligaments. Microscopical examination revealed plexiform epithelioma.

*Treatment.* On June 12, 1918, 8 unfiltered minute glass tubes, containing together 20 millicuries, were embedded in the ulcer, giving a dosage of 2640 millicurie hours; also 3 tubes containing together 131 millicuries, in 1 millimeter platinum, were applied for 28 hours, the tubes being arranged end-to-end and placed in the uterocervical canal. Following the treatment a rapid disappearance of the ulceration and induration took place.

March 15, 1919. No ulceration but an increase in the size of the cervix has developed with greater restriction of the mobility of the uterus due to a diffuse infiltration of the base of the broad ligaments. A deep recurrence of the disease has taken place and the ultimate diagnosis is bad.

**CASE 17.** Very advanced carcinoma of the cervix clinically improved for a brief period after one treatment. E. W. Hosp. No. 26093, age 41. The patient's previous health has been very good. She has five children, births normal, and she nursed each child. The menstrual history up to the time of the development of present trouble has been nor-

mal. Menstruation lasted five days and was regular, recurring each month. The patient applied for treatment December 17, 1918. In August, 1915, she began to bleed from the vagina between the menstrual periods. During the whole of 1916, 1917 and 1918, to the present time, there has been a continuous flow of blood, even more profuse than normal menstruation. She had influenza in November, 1918, since which time she has had pain in the back and left side. She has lost 15 pounds in weight and lately is somewhat constipated. Examination shows the vaginal surface of the cervix destroyed by an ulcerated hard mass continuous with a deep infiltration of the anterior vaginal wall and base of the broad ligaments. Mobility of the uterus is much restricted. Microscopical examination revealed carcinoma of the cervix.

*Treatment.* On December 17, 1918, 3 tubes, containing together 125 millicuries, in 1 millimeter platinum, were applied for 24½ hours, the tubes being arranged end-to-end in a rubber tube and placed in the uterocervical canal; also 9 tubes containing together 25 millicuries, were embedded in the tumor tissue.

March 1, 1919. Following the treatment she had one severe haemorrhage. A progressive healing of the ulceration and retrogression of the disease has, however, taken place. At present she is free from pain and has had no bleeding for two months, but the anterior vaginal wall and the cervix are still infiltrated with hard tissue. There is some bladder tenderness. The advanced stage of this patient's disease at the time she applied for treatment precludes the possibility of a cure, but the temporary relief from the haemorrhage and the pain meant everything to the patient.

#### RECURRENT CARCINOMA OF THE CERVIX—4 CASES; 2 CLINICALLY CURED, 16 AND 25 MONTHS AFTER TREATMENT, 1 IMPROVED.

CASE 1. Recurrent carcinoma of vaginal vault clinically cured to date, 25 months after first treatment by radium. A. D., Hosp. No. 24459, aged 48. The patient's previous health had been good. The menses had been regular and normal. She has 11 children. The uterus was removed five years ago for carcinoma. The patient applied for treatment May 31, 1917. Three months before the patient suffered frequent micturition but felt no pain. Examination showed the vaginal vault densely infiltrated by a fixed mass which was ulcerated on its surface. Microscopical examination showed epidermoid carcinoma.

*Treatment.* On June 4, 1917, 3 tubes containing together 53 milli-curries, in 2 millimeter lead, were applied for 8 hours, the tubes being placed against the tumor mass in a mold of dental modeling compound. On December 14, 1917, there was no evidence of disease. On January 12, 1918, there was some induration of the posterior wall in the vaginal vault. February 2, 1918, 2 unfiltered tubes containing together 9 milli-curries, were embedded in the indurated nodule. May 3, 1918, and on July 7, 1919, there was no evidence of disease.

CASE 2. Recurrent carcinoma of the cervix in the vault of the vagina, clinically cured to date after 3 applications of radium. A. H. Hosp., No. 25271, age 50. The patient had always had good health. The menses were normal. She had two children, both normal deliveries. In May, 1916, an operation by cautery was performed upon the uterus. In April, 1917, a hysterectomy was done. Recently induration has appeared in the vault of the vagina. The patient applied for treatment March 9, 1918, for recurrence which was detected by her surgeon. She

had no haemorrhage or pain. Examination showed in the vault of the vagina an ulcer about 2.5 inches in diameter involving the mucosa of both the anterior and posterior vaginal walls, except at the center, where it was covered with papillary nodules. Microscopical examination showed epidermoid carcinoma.

*Treatment.* On March 9, 1918, 3 unfiltered minute glass tubes, containing together 11 millicuries, were embedded in the lesion, giving a dosage of 1952 millicurie hours; May 25, 1918, 5 tubes, containing together 11.69 millicuries, were embedded in the lesion; October 23, 1918, 3 tubes, containing together 12.6 millicuries, were embedded in the lesion. On July 8, there was no evidence of disease, though a leakage of urine in the vagina had developed. The granulating area left after radium treatment has not entirely healed. October 9, there was practically a complete disappearance of all evidence of disease, although some indurated nodules still remained in the walls of the vagina.

March 1, 1919. The patient is free from all ulceration and local evidence of carcinoma. The vesicovaginal or ureterovaginal fistula still persists. Her general health is good, and aside from the fistula she is free from all discomfort. July 10, 1919, rectum and vagina free from any induration or evidence of cancer. The patient is perfectly comparsists. Her general health is good, and aside from the fistula she is small, and there is less leakage from it.

**CASE 3.** Recurrent carcinoma of the fundus, unsuccessfully treated. Death from metastases in 6 months. M. B., Hosp. No. 23959, age 56. The patient had previously had good health. On December 3, 1916, she applied for treatment. In 1913 she noticed a discharge from the vagina which was not accompanied with pain. A microscopical specimen was taken and curettage performed, but the discharge, which had become bloody, continued. In August, 1915, she suffered a severe haemorrhage. On October 12, 1915, a panhysterectomy was performed and since then she has never felt well. Microscopical examination revealed carcinoma of the uterus.

*Treatment.* On June 26, 1918, 5 unfiltered minute glass tubes, containing together 15 millicuries, were embedded in the nodules in the posterior vaginal walls, giving a dosage of 1980 millicurie hours. Present condition: There has been no further increase in the size of the nodules, though the induration at their site has not completely disappeared. Her poor health since the panhysterectomy has not improved. The patient died apparently from internal metastases in the early part of January, 1919.

**CASE 4.** Recurrent carcinoma of the uterus, improved by treatment. E. W. W., Hosp. No. 25421, age 62. The patient had enjoyed good health until 5 years ago. In April, 1913, she noticed a prolapse of either the cervix or the walls of the vagina, accompanied with bleeding from the vagina. In May she was curedtted and under a diagnosis of carcinoma the uterus was removed two weeks later. She was free from all symptoms for the next 4 years, when there was a recurrence of the bleeding. For this she was treated in Los Angeles with radium. The patient applied for treatment April 29, 1918. Between April 3, 1917, and May 8, 1917, the patient received four treatments of 9 millicuries of radium, 1 tube, in 5 millimeters silver, and 1.3 millimeters of brass applied in the ulcer 14 and 16 hours each. Examination showed a small ulceration in the vault of the vagina. Microscopical examination showed recurrent carcinoma of the cervix.

*Treatment.* On April 29, 1918, 1 tube of 108.6 millicuries, in 1 millimeter platinum, was applied for 8 hours, the tube being covered by a rubber tube placed over the base of the ulcer. On July 17, 1918, the induration had practically disappeared, but in the vault of the vagina was an ulcer covered with slough which was due to radium necrosis. Following this there was a progressive improvement in the patient's condition, the ulcer healing, the discharge diminishing and the tumor tissue being absent. January 17, 1919, all rectal and bladder irritation had ceased, but a blood-tinged discharge was still present. March 18, 1919, the ultimate prognosis in this case is probably bad, though the presence of the tumor at the present time cannot be proved. Her general health has been good since the radium treatment was begun.

## CARCINOMA OF THE FUNDUS—4 CASES; 2 IMPROVED FOR PERIODS OF 2 YEARS; 2 CLINICALLY CURED, 14 AND 21 MONTHS AFTER TREATMENT.

**CASE 1.** An early cancer of the fundus of the uterus. An apparent complete retrogression, with no evidence of recurrence for 2 years after treatment. A. S., Hosp. No. 23320, 70 years old. The patient had an early cancer of the body of the uterus with retrogression after one treatment. Examination on admission, June 5, 1914, shows the uterus slightly enlarged. There is a bloody discharge from the cervix. The cervix itself is not enlarged or ulcerated. The patient is fat and suffers some from dyspnoea on exertion. Her arteries are thickened and tortuous. Microscopical examination shows adenocarcinoma. Five weeks ago the patient noticed a blood discharge from the vagina and an uncomfortable bearing-down sensation. Three weeks ago she began to have pain in the back. These symptoms have gradually increased.

*Treatment.* Under nitrous oxide the uterus was curetted and the curettings showed on section adenocarcinoma. A tube containing a small quantity of radium was inserted into the uterus for 6 hours. July 31, 1914, a second treatment of 20 millicuries of radium was given for 8 hours. Following this treatment there has been no return of the menorrhagia nor any uterine symptoms whatever. The patient died in the summer of 1916 from apoplexy.

No examination was made later than a year after her treatment, but the entire absence of uterine symptoms during the second year following treatment justified the conclusion that there was no local recurrence.

**CASE 2.** Advanced carcinoma of the fundus, clinically arrested for 2 years by radium treatment. C. C., Hosp. No. 21999, 77 years old. The patient was admitted to the New York Hospital, September 13, 1914. The uterus and cervix were curetted. Both were found to contain much soft tissue. Examination per rectum showed that the growth had invaded the anterior rectal wall. Microscopical examination showed adenocarcinoma of the cervix and uterus. The patient entered the Memorial Hospital September 25, 1914, at which time 25 millicuries of radium emanation were inserted in the cervix for 4 hours. She left the hospital much improved. She returned in about 2 months, and not much improvement was noted since the previous treatment. The cervix was found to be enlarged once and a half its normal size and was hard. There was more or less vaginal discharge. Some restriction of the normal mobility of the cervix was noted. The base of the broad ligament was much thickened.

*Treatment.* April 13, 1915, 1 tube containing 50 millicuries, in 1 millimeter lead, covered with rubber, was applied in the cervical canal for 48 hours. Following this treatment there was vesical and rectal irritation, which subsided in the course of a few weeks. The patient then steadily improved and became free from all symptoms of her disease. Examination, February 13, 1917, revealed a small, shrunken cervix, free from all ulceration, and no evidence of disease involving the broad ligament. A few days before this examination she began to complain of a vague headache. About two weeks later she had pain and soreness in her right inguinal region, followed by tenderness over the right kidney region. The urine was scanty and high colored, and upon examination showed a large quantity of pus cells and bacteria. She had some nausea and vomiting, but no rise of temperature. Her general condition deteriorated rapidly and she died on March 16, 1917.

*Autopsy.* An abscess was found surrounding the lower pole of the right kidney with extension to the wall of the renal pelvis and beginning purulent interstitial inflammation of the kidney. The uterus was reduced to a nodule of tissue 2 by 1 by 1.5 centimeters and was surrounded by adherent intestinal coils and fused with bladder wall. The vagina was shortened and thickened but smooth. On section the uterus was found infiltrated by alveol of adenocarcinoma or malignant adenoma, in which the lining cells showed hydropic degeneration, but the nuclei stained well. Mitoses could not be found. The muscle tissue was extensively fibrosed. The rectal wall was fibrosed but free from cancer. The bladder wall was infiltrated by scanty adenocarcinomatous alveoli over an area of 2 centimeters in diameter, but the mucosa was intact.

In this case we can at least say that a clinical cure of two years' standing was obtained in an advanced cancer of the fundus of the uterus.

CASE 3. Operable carcinoma of the fundus, clinically cured to date, 21 months after one radium treatment. C. M. B., Hosp. No. 24889, age 40. The patient had had the usual diseases of childhood. In 1910 she became ill with a severe attack of dysentery and precordial pain. The trouble was later diagnosed as acute dilatation of the heart. The patient was kept in bed for over a year on a very rigid diet and since this treatment has only had a mild attack of precordial pain and tachycardia. The patient applied for treatment October 25, 1917. In 1915, profuse menstruation developed and first attracted the patient's attention to her present condition. The bleeding became more profuse and caused severe anaemia. Since August, 1916, she has had four very severe haemorrhages. Examination reveals a normal cervix, with a somewhat enlarged, movable uterus. Microscopical examination of a section made of the curettings obtained October 26, 1917, at which time the patient also received a radium treatment, showed adenocarcinoma.

*Treatment.* On October 26, 1917, 2 tubes, containing together 156 millicuries, enclosed in 1 millimeter platinum and 1.5 millimeters rubber, were applied for 8 hours in the cavity of the uterus. Following this treatment the haemorrhage ceased and there was progressive improvement of the patient's condition. A letter received from the patient, March 24, 1919, says that she feels better than she has for the past 8 years. Menstruation has entirely ceased, but the patient leads a sedentary life because of her cardiac condition, and to this she attributes the abdominal tympanities accompanied with occasional pain in the stomach and abdomen.

July 22, 1919, in telephone message, patient states she is free from discharge and as well as previously.

**CASE 4.** Operable carcinoma of the fundus, clinically cured to date, 14 months after one radium treatment. A. W., Hosp. No. 25442, age 62. The patient has enjoyed good health. The menses have been regular and normal. She has five children. Births have been normal. The menopause occurred 10 years ago. The patient applied for treatment in October, 1917, at which time a slight bleeding occurred. She received some local treatment, but the bleeding recurred in April, and she submitted to curettage. Microscopic examination of the curettings showed adenocarcinoma.

*Treatment.* May 6, 1918, 2 tubes, containing together 83 millicuries, in 1 millimeter platinum, were applied for 15 hours, the tubes being arranged end-to-end in a rubber tube placed in the uterocervical canal. Advice from the patient March 1, 1919 states that she is well and free from uterine symptoms July 11, 1919, examination of patient shows an absence of all evidence of disease, the uterus being practically normal.

**CARCINOMA OF THE EXTERNAL GENITALS—5 CASES: 3 CLINICALLY CURED TO DATE, 21 TO 16 MONTHS AFTER TREATMENT WAS BEGUN; 1 IMPROVED, 1 UNIMPROVED.**

**CASE 1.** Primary carcinoma of the labium minor and urethra, clinically cured to date, 21 months after the first radium treatment. A. W. L., Hosp. No. 24830, age 69. The patient has never been seriously ill. She applied for treatment October 8, 1917. For over a year she had noticed a very slight vaginal discharge, accompanied by very little discomfort. Several years previously a small caruncle was removed from the urethra. Several months ago the patient noticed a small mass which she thought to be another caruncle. The mass was about the size of a pea and caused some burning during micturition. Examination revealed upon the right border of the introitus a flat, slightly raised tumor 2 centimeters long and 2 centimeters wide. Its base and edge were hard and covered with neoplastic nodules, and extended upward into the vagina to just within the vaginal orifice. Microscopic examination showed epidermoid carcinoma.

*Treatment.* On October 9, 1917, 9 tubes, containing together 248 millicuries, in 1 millimeter silver, were applied for 1 $\frac{1}{4}$  hours, the tubes being applied over the ulcer and held in place in a mold of dental modeling compound. On January 8, 1917, the induration had practically disappeared except for two small tumor-like ulcers 0.5 centimeters in diameter. June 1, 1918, retrogression was almost complete except for a slight induration. On June 1, 9.2 millicuries in 4 unfiltered minute glass tubes were embedded in the tumor mass, giving a dose of 1214 millicurie hours. Following this treatment the patient continued to improve, and she failed to return for subsequent treatment until February 25, 1919, when an indurated nodule was discovered in the site of the original lesion. This was apparently a submucous recurrence and measured about 2 centimeters in diameter. February 26, 1919, 5 unfiltered minute glass tubes, containing together 16 millicuries, were embedded in the substance of the tumor mass, giving a dosage of 2112 millicurie hours. March 12, 1919, the nodule had almost disappeared. July 1, 1919, examined and absolutely no evidence of disease present.

**CASE 2.** Primary carcinoma of the clitoris, clinically cured to date,

## RADIUM

19 months after one radium treatment. E. S., Hosp. No. 25160, age 60. The patient has enjoyed good health. She applied for treatment January 1, 1918. Her present illness began in September, 1917, when she first noticed burning and a small swelling in the neighborhood of the labium and clitoris. This swelling increased slightly in size to the present time and the burning sensation had become more disagreeable. Examination revealed in the anterior right labium minor two large nodules, 2 centimeters in diameter. These were ulcerated on the surface and the two bases were broad and hard with deep infiltration of the underlying tissues. The anterior nodule involved the clitoris. Microscopical examination showed epidermoid carcinoma.

*Treatment.* January 1, 1918, 6 tubes, containing together 303.7 millicuries, in 0.5 millimeter silver, were applied for 1.5 hours, the tubes being placed against the surface of the lesion, embedded in dental modeling compound; also 3 tubes, containing together 9.3 millicuries, without filtration, were embedded in the tumor mass, giving a dosage of 1327 millicurie hours. Following the treatment there was a gradual disappearance of the induration. On September 30, 1918, there was no evidence of the disease. July 11, 1919, there was still no evidence of disease.

**CASE 3.** Advanced carcinoma of labium minor. Death from erysipelas following treatment by buried emanation. I. S. A., Hosp. No. 25164, age 65. The patient had scarlet fever and diphtheria when a child. She has never been very strong. During the past few years she has been troubled with almost constant diarrhoea. The patient applied for treatment January 29, 1918. One year ago she noticed a small ulcer on the right labium, unaccompanied with pain, but causing itching and burning. Last September a discharge developed which has gradually increased to the present time. Examination showed upon the right labium an ulcer 2.5 centimeters in diameter. There was also a large nodule in the right inguinal region 1 centimeter in diameter. Microscopical examination showed epidermoid carcinoma.

*Treatment.* January 29, 1918, 2 unfiltered minute glass tubes, containing together 17.1 millicuries, were embedded in the base of the ulcer, giving a dosage of 2240 millicurie hours. Following the treatment the patient developed erysipelas, from which she died March 8, 1918. At the time of death there was an almost complete disappearance of the induration at the primary site of the disease.

**CASE 4.** Primary carcinoma of the urethral meatus and labium minor, clinically cured to date, by 3 radium treatments. Duration, 16 months after the first treatment J. H. Hosp. No. 25283, age 42. The patient had diphtheria when 12 years old. A large fibroid was removed from the uterus 8 years ago. The patient applied for treatment March 12, 1918. Three months ago she had noticed first a slight vaginal discharge which at first was intermittent and later continuous. Two months before application for treatment she noticed a soreness in the labia minora. Six weeks ago micturition became painful and these symptoms have increased slightly to the present time. Examination shows surrounding the urethral meatus and destroying the anterior two-thirds of the right labium minor an ulcer with an indurated base and papillary surface 2.5 centimeters in diameter. The anterior border involves the clitoris. The induration of its base is deep seated and extends 2 centimeters upward into the superior vaginal wall. Microscopical examination showed epidermoid carcinoma.

*Treatment.* On March 14, 1918, 5 unfiltered minute glass tubes, containing together 11.3 millicuries, were embedded in the base of the ulcer, giving a dosage of 1,491 millicurie hours; also 5 tubes, containing together 152.3 millicuries, in 0.5 millimeter silver were applied for 3 hours against the ulcer, in dental modeling compound. On July 2, 1918, 12 unfiltered minute glass tubes, containing together 15 millicuries, were embedded in the residual induration, giving a dosage of 1,980 millicurie hours. Following the first two treatments the patient gradually improved until July, when the ulceration was almost healed, but there remained considerable induration. Following the treatment in July, improvement continued until January 2, 1919, when all evidence of the disease had disappeared with the exception of a small pea-sized nodule of doubtful significance in the posterior right labium. To insure safety this was treated on January 16, 1919, 2 unfiltered minute glass tubes, containing together 7.8 millicuries, being embedded beneath the nodule, giving a dosage of 1,129 millicurie hours. March 1, 1919, nodule undergoing rapid disappearance. July 7, 1919, no evidence of disease.

**CASE 5.** Advanced carcinoma of labia majora, held in check for 1 year by two radium treatments. M. E. H., Hosp. No. 25434, age 57. The patient has enjoyed good health except for the usual diseases of childhood. She applied for treatment May 3, 1918. One year ago she noticed itching of the vulva. This increased in severity and later was replaced by burning and severe irritation during micturition. Several months ago an ulcer was located in the labia which was treated with local application. Examination of the left labium major shows a large elevated, flattened ulcer. It measures 5 to 6 centimeters in diameter. The base is hard and covered with neoplastic nodules. There are enlarged glands palpable in the groin. Microscopical examination shows epidermoid carcinoma.

*Treatment.* May 4, 1918, 5 unfiltered minute glass tubes, containing together 11.8 millicuries, were embedded in the tumor mass, giving a dosage of 1,557 millicurie hours; also 9 tubes, containing together 587.2 millicuries, filtered through 5 millimeters silver, were applied for 2 hours, the tubes being placed over the lesion in dental modeling compound. Following this treatment there has been progressive improvement. The patient, however, was examined at irregular intervals, due to the distance at which she lived from New York. March 12, 1919, the original lesion has been replaced with cicatrix depressed in the center and of a somewhat leathery consistency in the periphery. Two pea-sized hard nodules of suspicious character are present in this peripheral portion. The inguinal glands are not enlarged. The patient is practically free from discomfort and although an ultimate cure is not expected on account of the size of the original lesion, the patient up to the present time has a clinical cure of nearly a year's standing and is still improving. Renewed activity of growth became manifest in April, 1919, and on April 16, 1919, a second treatment of 2300 millicurie hours by buried emanation was administered.

These cases, 30 in number, have a post-therapeutic period, varying from 3 1-3 years to 6 months, and comprise 17 carcinomata of the cervix, 4 recurrent carcinomata of the cervix, 4 carcinomata of the fundus, and 5 carcinomata of the vulva (labia minora and clitoris).

Of the 17 carcinomata of the cervix, the post-therapeutic period is one in 3 1-3 years, in another 3 years, and in a third 1 3/4 years. Nine of the remaining cases, all treated within the past year, have undergone

## RADIUM

the same continuous retrogression after a single treatment, as the first three cases treated with the longer post-therapeutic period.

Five of the 17 carcinomata of the cervix have returned after the first treatment and are again under treatment. The fact, however, that they have developed a recurrence is deemed a very unfavorable factor in their ultimate prognosis. In 2 of these cases a large portion of the vaginal wall was involved. Two others had bad symptoms of bleeding for many months before the radium treatment. The remaining case had a very advanced lesion, has been treated recently and is still under observation.

All 4 of the cases which developed a recurrence showed a primary retrogression which was complete for a short period in 2 cases and became almost complete in the other two. In all four of these cases the recurrence or renewed growth developed within 4 months from the time of the first treatment. The fifth case is still improving, but was so extensive at the time of treatment that a cure is not expected.

Of the 4 patients with carcinoma of the fundus, one, an old lady, died of intercurrent disease, two years after the radium treatment. She never had any return of her uterine symptoms. A second patient remained in perfect health for 2 years from the time of her first treatment. The third patient, treated 1½ years ago, and the fourth patient, treated within the past year, are still free from symptoms.

Of the 4 recurrent cases, one patient treated first two years ago, is still free from any evidence of disease. Another, first treated a year ago, is free from evidence of disease. A third, treated 2 years ago, has recently required another treatment and at present shows symptoms of metastasis in the upper pelvic glands. The fourth case was not improved.

The greatest interest centers around the 5 cases of carcinoma of the vulva. In one of these the lesion involved the clitoris and in the other 4 the labia minora, the urethral orifice and anterior vaginal wall. In 2 of these cases a clinically complete retrogression followed treatment. One of these patients developed a recurrence which is at present satisfactorily retrogressing after a second treatment. The other has remained free from evidence of disease for 15 months since her treatment. In the third patient, wholly inoperable, the retrogression is at present so complete that a cure is expected.

A fourth patient with a very advanced lesion is still improving and under treatment. While none of these five patients can be classed as cures it must be remembered that in all but one progressive improvement of over a year's standing and amounting to a fairly complete retrogression followed the radium treatment, a result which is better than that usually following operation for this form of cancer.

Of equal importance with the consideration of the results of the treatment of uterine cancer with radium is a consideration of the methods by which these results have been obtained.

The majority of radium therapeutists in gynecology use single tubes. These are inserted inside the uterus or within the cervical canal, or against the vaginal surface of the cervix, or in several of these locations, at the same or at alternate treatments.

The dosage generally used has been heavy, sufficient to cause excessive sloughing, and entirely too heavy for almost any other region of

the body. Bumm, for instance, recommends a total dosage of 8700 milligram hours to 15,000 milligram hours.\*

Cheron and Rubens Duval use the Dominici tubes, wrapped in gauze and placed in the vagina, and give 48 to 7200 milligram hours, repeating this treatment when they deem it necessary.

Schauta recommends the use of 50 milligrams filtered by 2 millimeters of lead, applied for five days, or 6000 milligram hours, and the repetition of this dose in ten days' time, giving thus virtually 12,000 milligram hours. In eleven cases he has had two severe haemorrhages, one vesicovaginal fistula and one rectovaginal fistula.

Schindler uses as small a quantity of radium carbonate as corresponding to 27 milligrams of pure radium bromide. This is enclosed in a lead capsule 1.3 millimeters thick and placed within the vagina for days.

Scherer and Keley filter through 1.3 millimeters lead and use a total dosage of 3820 milligram hours.

Latzo and Schueler use the Dominici tubes of 0.5 millimeter silver covered with 1½ to 3 millimeter lead and a dosage of 15,300 to 16,800 milligram hours.

Doederlein gives 12,000 to 14,000 milligram hours, in divided doses in the course of 1 to 2 months.

Dobbert recommends 2400 milligram hours repeated every third day until 6000 to 7000 milligram hours have been given. He filters through gold and brass, rarely through lead.

Weinbrenner gives 8004 to 13,680 milligram hours and filters through silver.

Allman uses 150 to 200 milligrams of radium bromide of 24 hours, 3600 to 4800 milligram hours, repeating the treatment at intervals of two to four weeks. He uses nickel plated brass filters. He had severe symptoms in a number of patients from over-dosage.

Burrows uses a strong application within the cervix, 50 to 60 milli-curies of emanation filtered through 1 millimeter of silver and simultaneously two to three needles containing emanation thrust into the broad ligaments and posterior lip of the cervix, left in place 24 to 48 hours.

This treatment is further reinforced by the application of varnish-plates over the abdomen.

Kelly and Burnam have not yet described their technique.

St. Clair has successfully used as small a quantity as 10 milligrams of radium, applied within the cervix and uterus, six times at intervals of 6 to 8 days, for 24 hours each time, a total dosage of only 1440 milligram hours.

Sir Thomas Oliver obtained his excellent result from a single application of 24 hours' duration, of a single tube of emanation, containing

\*Dosage of radium and mesothorium as given by some of the Continental and English workers has been expressed in terms of the milligram of crystalline radium bromide which contains 53.6 per cent. of radium element; whereas, dosage as now expressed in this country and by most men abroad is based on the milligram of radium element or its equivalent, the millicurie of radium emanation. Unfortunately in some instances the authors, in stating their dosage, have neglected to indicate the unit they have used and it would be presumed that where these apparently excessive dosages have been used the unit has been crystalline radium bromide. To express these results in terms of the milligram of radium element, the numbers must be multiplied by the factor 0.536 or in other words, roughly, divided by 2.—Ed.

## RADIUM

probably 50 to 100 millicuries of emanation, in other words, 1200 to 2400 milligram hours.

Von Graff reports severe effects from over-exposure. He used at first 250 milligrams and later 40 milligrams for 24 to 48 hours. This is repeated once or twice at intervals of 2 to 3 days and of a second series of exposures given in two to three weeks. This probably represents 1000 to 2000 milligram hours at each exposure. He reports no bad effects from his later weaker dosage.

Schmitz, who has furnished a very favorable report, uses 50 milligram radium element for 40 to 48 hours, giving as a rule two treatments, 12 to 36 hours apart. This amounts to 2000 to 2400 milligram hours. The radium is filtered through brass 1.2 millimeters thick. It is divided into two tubes arranged tandem. These are applied within the cervix, and reinforced by crossfire from a second application of two tubes, arranged side by side, and applied against the cervix. Thus the total milligram hours amounts to 4000 to 4800 milligram hours. This treatment is repeated in three weeks' time but only if there is no great change. If improvement occurs the consideration of further treatment is postponed for another three weeks. Schmitz also cites experiments on cutaneous nodules of breast cancer which demonstrated that the gamma rays from 50 milligrams of radium element, applied for 12 hours (600 milligram hours) will destroy carcinomatous tissue 1 centimeter distant.

Clark describes his dosage only in connection with uterine myomata and here refers to 50 milligrams for 24 hours or 1200 milligram hours, as a large dose for the interior of the uterus. We assume that he uses a similar dosage for cancer.

Bailey formerly used a dosage of 3000 millicuries in the vagina applied to the cervix and filtered through 1 millimeter platinum. A dose of 600 millicurie hours is applied within the cervix, and 600 millicurie hours directed toward each parametrium. In addition to this, 3000 millicurie hours is applied over the abdomen in three places, over the center of the abdomen, and over each inguinal region. He now uses 2000 millicurie hours in one platinum tube placed in the cervical canal and 3000 millicurie hours from his bomb directed in fractions of 1000 millicurie hours each in three different directions against the cervix and a total of 18,000 millicurie hours applied externally at a distance of 4 centimeters from the spine over six different areas in a circle around the pelvis, i. e., 3000 millicurie hours over each area.

Recasens uses 70 milligrams of radium for 20 to 24 hours. He has used 130 milligrams for as long as four hours. In other words, 1400 to 1680, or even 6240 milligram hours. This treatment is repeated after an interval of 8 days and again a third time after another 8 days. It is again repeated after 20 days and sometimes altogether six or eight applications are made, two months elapsing between the later applications.

Of these methods of treatment that of Schmitz corresponds more closely than the others with our own. We believe it important in the treatment, at least of cervical cancer, to crossfire from within the cervical canal and from the surface of the ulcer. Moreover we cannot understand the heavy dosage recommended by many of those whom we have quoted.

In our experience one treatment appears to be all that is required in many cases. The two cases which we here report having gone the

longest time, one of them 3 years and 4 months and the other 3 years, have each received only one treatment.

For the average favorable case 6000 millicurie hours in one treatment may be all that is necessary, while a repetition of this treatment at too soon an interval, or increasing it, may cause the patient much unnecessary discomfort, or produce fistulæ.

The radium should be divided equally among six tubes. These tubes may be the regular Dominici tubes of 0.5 millimeter silver, but we prefer tubes of 1 millimeter platinum. The tubes which we use are 2 centimeters long, with a central radium containing portion  $1\frac{1}{4}$  centimeters long and walls 1 millimeter thick. Such tubes have the filtering power of 2 millimeters of lead and are less bulky.

While the Dominici tube filters out practically all the alpha and beta rays it does not filter out many of the soft gamma rays. One millimeter of platinum or 2 millimeters of lead filters out also the softer gamma rays. One millimeter of platinum or 2 millimeters of lead permits, therefore, the use of a much larger percentage of deeply penetrating radiations, which are far more homogeneous. Radiations from radium filtered in this manner must be used for a longer period and so used will exert a far more distant effect and a much better defined selective action.

For cancer of both the fundus and the cervix we advise the use of three of these tubes containing 150 milligrams of radium and inserted in the uterocervical canal, arranged end-to-end in a long rubber tube. For cancer of the cervix three additional tubes are placed against the cervical ulcer. The tubes placed against the cervical ulcer should be distributed evenly over its surface and the best method of retaining them in such a position, is by embedding them within a mold of the cervical ulcer and vagina made of dental modeling compound. This compound is the preparation which dentists use for obtaining impressions of the teeth. Placed in hot water it becomes soft, like putty, and in this condition may be inserted into the vagina. Left there it cools to the body temperature, at which it becomes hard enough to retain its shape. It forms, therefore, a perfect mold of the interior of the vagina and may be easily removed and reinserted and when reinserted it always finds the same position in the vagina. Upon this mold is an impression of the cervical ulcer. The three radium tubes may be embedded at equal distances from each other within the area of the mold which shows the impression made by the cervical ulceration. When the mold then is reinserted into the vagina, these tubes come into accurate opposition and are evenly distributed over the ulcer. This mold serves an additional function in holding the vaginal walls and with them the bladder and rectum away from the cervix and the radium lying against it, and thus protects these organs from burning. If the radium is so placed that it comes into dangerous proximity to the bladder and rectum a piece of lead may be embedded behind it, in the opposite surface of the mold, thus still more completely insuring the protection of the bladder and rectum. An absolute protection of the bladder and rectum and overhanging vaginal walls is not desirable. Schottlaender and Kermäuner have shown that in a definite percentage of cases of cancer of the cervix, metastatic extensions are already present in the vaginal walls, at some distance from the cervix. It is, therefore, not desirable to protect the vagina too strongly when applying radium to the cervix.

## RADIUM

Some protection is advantageous because in its absence disagreeable bladder and rectal tenesmus and discomfort from burning in the vagina can follow strong applications to the cervix. The cervix itself is practically insensitive to strong treatment. I have found that the separation of the vaginal walls by the dental molds is sufficient and yet allows a desirable amount of radiation of the vagina.

Special provision for directing strong radiations against the broad ligaments with a comparative neglect of the anterior and posterior parametrium is probably unsafe as compared to a uniform radiation of all the parametrial tissue.

Schottlaender and Kermáuner have shown that the regions in front and behind the cervix are frequently involved by the direct extensions of the growth.

The distribution of the radiations should, therefore, be made as diffuse as possible around the cervical ulcer as a center.

Attempts to supplement the internal treatment of uterine cancer for the purpose of more effectively reaching extensions into the uterus, broad ligaments and lymph nodes by the application of heavily filtered radium over the abdomen are of undetermined value.

Bailey in his excellent work uses such cross-firing through the abdomen in all his cases. Levine and Koernig have good results from cross-firing by X-ray radiations. My own experience in the treatment of epidermoid cancer in the deep cervical lymphatics, where the effects of the treatment can be followed with greater accuracy, and in a few advanced cases of uterine cancer confirms the experience of these men and indicates that a definite additional impression is made upon the extensions of uterine cancer by crossfiring through the abdomen. We are not, therefore, justified in neglecting this accessory means of treating uterine cancer. Nevertheless its importance must not be overrated, for there are some objections to its use. When the crossfiring is given by radium, and this is the agent of choice because its radiations are more penetrating than the X-ray radiations, large quantities are needed. These quantities are only available in a few stations. Moreover, their use prevents the treatment of other patients. The X-rays, which will be further improved in the future, are a more practical means of cross-firing uterine cancer through the abdomen, but even the use of these rays seriously complicates the treatment for many patients.

Until, therefore, the indications for the use of crossfiring through the abdomen are more thoroughly understood, until we know how much more it accomplishes than palliative improvement, a failure to be able to give it should not be regarded as a contra-indication to the treatment of uterine cancer by local applications alone.

It must not be forgotten that uterine cancer when still limited to the regions of its primary appearance is curable by these local applications alone. None of the cases, for instance, in this report has received any other treatment.

The dosage which I have found safe and efficient in cancer of the cervix, the radium being distributed as above described, is 6000 millicurie hours, i. e., divided into 3000 millicurie hours within the uterus and 3000 millicurie hours against the cervix, in other words, it is recommended that the radium should be divided into 6 tubes for the treatment of cervical cancer and, if each tube contains 50 milligrams, 3 of the tubes arranged end-to-end are placed in the uterocervical canal for

20 hours and the other 3 against the cervical ulcer for the same length of time.

One of these treatments may cause a complete retrogression, and a repetition of the treatment may not be necessary. In our experience the best results have been obtained when a repetition of the treatment was not necessary.

Theoretically this is so and should prove so practically for just as the success of the removal of the cancer by operation is best when the removal is complete, so every effort should be made completely to destroy carcinoma of the uterus by one blow, when it is first seen, and, therefore, most limited around the site of origin. If repetitions of the treatment become necessary a long interval should elapse and much care used in making the second treatment, as the tissues will not bear the same dose a second time so well.

We believe there is some advantage in cervical cancer in the use of emanation enclosed within minute glass tubes, which are embedded in the tumor mass instead of the surface application of radium.

We recommend the use of 20 to 30 or 40 millicuries of emanation according to the size of the tumor treated, distributed as evenly as possible throughout the tumor. Bagg has shown that 1 millicurie will produce a general necrotic effect through a sphere of tissue surrounding the tube for a distance of 1 centimeter. It is important, therefore, that the amount of emanation in each tube should be reduced to a minimum consistent with the avoidance of objectionable trauma, dependent on the introduction of too many tubes. The dose from 20 to 40 millicuries of emanation is 2640 to 5280 millicurie hours.

From our experience with unfiltered emanation in other regions of the body, the intense shower of beta and soft gamma radiations, having it is true, a more limited radius of effectual activity, produces a more complete destruction of cancer than the more penetrating gamma radiations alone. These are more accurately applied and distribute the radiations more evenly through the cancer tissue, and subject the patient to less inconvenience than any other method of treatment.

A review of the cases reported in this paper does not, of course, prove that radium is, at the present time, the method of choice for treating primary carcinoma of the fundus or cervix uteri. Taken, however, in conjunction with the other reports in the literature above quoted, it suggests that in only a few years there will be ample proof that radium is the method of choice in the treatment of cancer of the uterus, at least of that most frequent form of cancer of the uterus and most difficult to manage by operation, cancer of the cervix.

The presentation of the evidence furnished by this report may, therefore, be premature in so far as operable cancer of the uterus is concerned. It is, however, conclusive for cancer of doubtful operability, but so strong for operable cancer of the cervix that in the light of the other published observations the treatment of early cancer of the cervix by radium is, at the present time, justified.

More than this, it suggests that it is unjust to the women of the country to wait 3 to 5 years longer before the widespread distribution of radium throughout the country is planned for.

Each medical center in the country should plan to own sufficient radium to care for at least the uterine cancers of its district. While it is

## RADIUM

desirable that sufficient radium should be purchased by each of these centers to permit the use of emanation and this supply be placed under the care of a trained man \*who can properly become responsible for its use by the physicians of the district concerned, yet for the treatment of uterine cancer alone the use of emanation is not an absolute necessity. The treatment used in the vast majority of the cases thus far reported, and in the author's earlier cases, those having remained well the longest, has not been by emanation and is quite within the power of the private owner of radium. This treatment has proved efficient. In the later cases the author has preferred the combination of filtered radium emanation with the embedding in the cervical ulceration of unfiltered emanation tubes. The advantages offered by this combination at least in treatment of uterine cancer, may be sacrificed when the use of radium itself is only possible. These facts are important because they make practical the treatment of cancer of the cervix generally throughout the country.

When we consider that at a conservative estimate 8000 to 9000 women die of carcinoma of the uterus each year in the United States\*\* and that a search, as elaborate as can be made through the published reports, including as these reports do, circular letters sent out by Cullen and Taussig, through the South and West in the United States, finds only 61 women operated upon five years prior to 1916, who have been cured of carcinoma of the cervix uteri, can any consideration justify the postponement of the general use of radium in the treatment of uterine carcinoma? While, of course, more than 61 women up to 5 years ago have been cured by operation of cancer of the cervix, in this country, yet it is safe to say that this number indicates what a drop in the bucket the operative treatment of cancer of the cervix uteri is toward meeting the real demands of this malady upon the medical profession. But granting that the radical abdominal operation could cure 100 per cent of the operable patients of cancer of the cervix, applying for treatment, there are not in the country a sufficient number of capable surgeons to do the required work.

Contrasting with this record the record which radium has already made, however immature this record may be, the fact it has produced cures of two to four years' standing in cases too extensive for operation; that it has produced cures of three years' standing and over, in a larger percentage of early cases than operation has produced, one author claiming for it in this stage 100 per cent of cures; the fact that treatment by it in no way interferes with the patient's routine life and subjects her life to no risk; the fact that it is a remedy capable of being used by any one possessing the simplest gynecological training, after receiving certain easily acquired technical instruction; contrasting these facts with the operative records, is not the time ripe to urge each county medical society to make the effort to place a supply of radium in its

\*A suggestion would be that men living near Universities get together to secure a sufficiently large quantity of radium and place it in the Physics Department of the University and in this way make it possible for themselves to use radium emanation. Their emanation apparatus would be cared for well in this manner and almost any Physics Department of a University would be willing to do such work for the privilege of using some of the emanation for scientific or educational work. This emanation could easily be spared from that which would go unused for medical purposes.

\*\*The 17th annual report of the mortality statistics of the Bureau of Census for 1916 states that there were: 58,600 deaths from cancer that year, 8,898 deaths or 15.2% were from cancer of the female generative organs, divided as follows: ovary and fallopian tube, 544; uterus, 8,085; vagina and vulva, 218; unclassified, 51.

district? Three hundred milligrams are sufficient for the treatment of one case every 24 hours. Less may be successfully used but if so the treatments must be longer and the number of cases treated less.

Aside from the relief in advanced cases, can there be any doubt that, if such a plan be carried out, more cases of cancer of the uterus would be cured than are now saved by operation and a knowledge of this fact soon go further in inducing women to seek help in an early stage than are at present induced by the attractions of a radical abdominal operation?

The strong argument for the radical abdominal operation has always been the fact that it is the only method by which lymphatic metastases may successfully be removed, and yet few of the cases with such metastases have ever been cured by operation.

Wibel, of the Wertheim clinic, states that 25 per cent of all cases upon which he operated had cancerous glands and nearly all died of recurrences. In his whole series only ten such cases remained well five years.

Sampson reports one case cured in which a metastasis was found in the lymphatic gland.

Clark states that, if the higher pelvic lymphatic systems are the seat of metastases, it is scarcely possible for the widest and most painstaking dissection to completely eradicate it.

None of Busse's cases in which the presence of carcinoma in the lymphatics was demonstrated ultimately recovered.

Hofmeier saved no case in which the removed glands contained carcinoma.

Schottlaender and Kernauner state on page 456 of their book on carcinoma of the uterus, based on the 256 operations of von Rosthorn's clinic, that in the later year not much importance was attached to the necessity of removal of glands, and in the review which the author gave this book, he found no case which ultimately recovered in which the glands removed contained carcinoma.

We may conclude then that only isolated cures can be obtained by any method when the cancer has left its primary site, so that any error made in neglecting attention to the higher pelvic lymphatic glands is more than offset by higher mortality accompanying attempts to remove them.

Cancer of the cervix, in probably the majority of cases, displays a strong disposition to remain localized for a long period. Zweifel, for instance, records 23 operations for recurrent cancer of the cervix, of which 7 were free from further recurrence seven and a half years.

If cases with cancerous lymphatics can be cured, it is far better to attempt to do so by opening the abdomen after treating the primary disease with radium and embedding emanation in the enlarged glands. We have evidence in our work with radium in the mouth that its effect extends to the first set of regional lymphatics.

From the therapeutic standpoint, cancer of the uterus must be regarded as a local disease, and the most practical method of handling the disease at its site of origin must be adopted.

Our present evidence indicates that radium destroys the disease at this site to a greater distance than the knife is capable of removing it, and does this with no risk or inconvenience to the patient and only a small tax on the skill of the surgeon. Every effort should, therefore, be made to secure its general use throughout the country.

## BIBLIOGRAPHY

ABBE, R. Uterine fibroids, menorrhagia and radium. *Med. Rec.*, 1915, lxxxvii, 379-381.

ADLER. Ueber Radiumbehandlung bei Gebaermutter Krebs. *Monatschr. f. Geburts. u. Gynaek.*, xli, 145.

ALLMAN. Zur nicht operativen Karzinombehandlung. *Strahlentherapie*, 1914, iv, 625.

BAILEY, H. Radium in uterine cancer. *Surg., Gynec. & Obst.*, 1918, xxvi, 6, 625.

BAISCH, K. Erfolge der Mesothoriumbehandlung bei 100 Uteruskarzinomen. *Muenchen. med. Wchnschr.*, 1915, lxii, 1670.

BERGONIE, J., and SPEDER, L. Le traitement du cancer uterin inoperable par la rontgen therapie et la radium therapie combinees. *Arch. d'elect. med.*, 1915, xxiii, 140-148.

BOVEE, J. W. Statistics of radical operation for cancer of cervix uteri. *Am. J. Obst.*, 1912, lxvi, 380.

BUMM. Ueber die Erfolge der Roentgen und Mesothorium Behandlung beim Uteruskarcinom. *Deutsche Gesellsch. f. Gynaek*, Halle, 1913.

BUMM, E. Weitere Erfolgerungen ueber Karcinombestrahlung. *Berl. klin. Wchnschr.*, 1914 lix, 193.

BUMM, F. *Ztschr. f. Krebsforsch.*, 1910, x, 105.

BURROWS, S. Radium treatment of cancer of the cervix of the uterus. *Am. J. Surg.*, 1915, xxix, 296.

BUSSE, W. V. Dauer-resultate bei dem Operation des Uteruskarcinoma nach den abdominalen Methoden. *Monatschr. f. Geburtsch. u. Gynaek.*, 1912, xxxv, 35.

CHERON, H., and RUBENS-DUVAL, H. Ueber den Wert der Radiumtherapie in der Behandlung der uterinen und vaginalen Krebse. *Fortsch. a. d. Geb. d. Roetgenstrahl.*, 1913, xxi, 229.

CLARK, JOHN G. The therapeutic use of radium in gynecology. *Surg., Gynec. & Obst.*, 1918, xxvi, 619.

Idem. The radical abdominal operation for cancer of the uterus. *Surg., Gynec. & Obst.*, 1913, xvi, 255.

COBB, F. Cancer of the uterus with special reference to the possibilities of cure by a radical abdominal operation. *Boston M. & S. J.*, 1914, clxxi, 731.

CULLEN, THOMAS S. Radical operation for cancer of the uterus. *Surg., Gynec. & Obst.*, 1913, xvi, 265.

DEGRAIS, P. Radium therapie du cancer du col de l'uterus. *Ann. de gynec. et d'obst.*, 1915, xi, 609; *Surg. Gynec. & Obst.*, xxii, 3, 298.

DENT. *Gesellsch. f. Gynaek*, Halle, 1913, May.

DIEFFENBACH, W. H. Radium in the treatment of cancer. *Med. Rec.*, 1913, lxxiv, 1068-1072.

DOBBERT, T. Ergebnisse der Behandlung des Gebaermutter-Krebses mit Radium. *St. Peters. m. Ztschr.*, 1914, xxxix, 97.

DOEDERLEIN. Roentgen-Mesothorium Behandlung bei Myom und Carcinom des Uterus. *Surg., Gynec. & Obst.*, 1913, xvii, 428.

DOEDERLEIN, A., and SEUFFERT, E. Unsere weiteren Erfahrungen mit der Mesothorium Behandlung des Carcinoms. *Muenchen. med. Wchnschr.*, 1914, lxi, 225.

Idem. *Zentralbl. f. Gynaek.*, 1915, xxxiv, 12, 177.

ESQUERIDO. Resultadas de la application del radium en el cancer del utero. *Therapia*, Barcelona, 1917, ix, 681.

FABRE. Les indications de la radium therapie dans le traitement du can-

cer de l'uterus. Ann. de gynec. et d'obst., 1915, xi, 620.

FAURE, J. L., Traitement du cancer du col de l'uterus par l'hysterectionie abdominale. Bull. et mem. Soc. de chir. de Par., 1913, xxxix, 1061.

FLATAU, S. Duerfen wir operable Uterus-Karcinome ausschliesslich Bestrahlen? Zentralbl. f. Gynaek., xxxix, 611.

FOVEAU DE COURMEL LES (Paris). 1st part, le rayons X; 2nd part, le radium en gynecologie. XXVII Internat. Congr. Med., Lond., 1913, viii, 79-96.

FUETH, H., and EBELER, F. Radiotherapy of cancer. Zentralbl. f. Gynaek., xxxix, No. 14, 217.

GRAFF, E. Ueber die bisherigen Erfahrungen mit Radium und Roentgenstrahlen bei der Krebsbehandlung. Strahlentherapie, 1915 v, 627.

HEIMANN, F. Le traitement radio et radium therapeutique des cancers uterins. Arch. d'electricite med., 1917, xxv, 530.

HOFMEIER, M. Zur operative Behandlung der Carcinoma colli uteri. Ztschr. f. Geburtsh. u. Gynaek., 1911, lxix, 453.

JACOBS. Roentgen and radium therapy in gynecology. Discussion. XXVII Internat. Cong. Med., Sect. VIII (2), Obst. & Gynaec., Lond., 1913, 198.

KEENE. Radiotherapy in Gynecology. Penn. M. J., 1917, xx, 469.

KELLY, H. A., and BURNAM, C. F. Radium in the treatment of carcinomata of the cervix uteri and vagina. J. Am. M. Ass., 1915, lxv, 1874.

KLEIN, G. Roentgen and radium therapy in gynecology, discussion. XXVII International Cong., Lond., 1913, viii (2), 200.

KOLISCHER, G. Modern radiotherapy in malignant tumors and localized tuberculosis. Lancet-Clin., 1915, lxxiv, 287-289.

KOLITZ, R. Economie d'energie rayonnante dans le traitement du cancer inoperable. Arch. d'electricite med., 1917, xxv, 430.

KRINISKI, L. A. Die operative Behandlung des Portio Carcinoms. Verhandl. d. 1. russ. Krebskong. St. Petersb., 1914: by Zentralbl. f. d. ges. Gynaek., Geburtsh. u. d. Grenzgeb.

KROEMER (Greifswald). Roentgen and radium therapy in gynecology. XXVII Internat. Cong. Med., Lond., 1913, viii (2), 193-195.

KROENIG. Roentgen rays, radium and mesothorium in the treatment of uterine fibroids and malignant tumors. Am. J. Obst., 1914, lxxix, 205.

LABHARDT, A. Corre.-Bl. f. schweiz. Aerzte, 1917, xlvii, 961-973.

LEGNEU and CHERON. Guerison par radium therapie d'un cancer uretrovaginal inoperable. J. d'urol., 1914, v. 3.

MAIOLO, G. C. Osservazioni cliniche sulla radium terapie ai 50 casi di carcinoma uterino. Ann. di ostet. e ginec., Milano, 1917, xli, 99.

MEYERS. Radium in the treatment of cancer of the uterus. Iowa St. M. J., 1918, viii, 296.

MILER, C. J. Radium in the treatment of carcinoma of the cervix. Surg. Gynec. & Obst., 1916, xxii, 437.

MORTON, W. M. J. Radium for the treatment of cancer and lupus. Med. Rec., 1907, lxxii, 760-766.

NEEL J. CRAIG. Results after the Wertheim operation for carcinoma of the cervix of the uterus. Surg., Gynec. & Obst., 1913, xvi, 293.

OERTEL, T. E. The present status of radium; report of cases treated. J. M. Ass. Georgia, 1914, 180-181.

OLIVER, SIR THOMAS. Radium and its efficiency in cancer of the vulva. Lancet. 1915, 1. Feb. 6, 272.

PETERSON, REUBEN. The extending operation of carcinoma of the

RADIUM

uterus. *Surg., Gynec. & Obst.*, 1916, xxiii, 237; *Tr. Am. Gynec. Soc.*, 1916.

Pozzi, S., and Rouhier, G. De l'hysterectomy restreinte completee par la radium therapie dans les cancers de l'uterus. *Rev. gynec. et chir. abdom.*, 1914-1915, xxiii, 209-264.

Prochownick, L. Behandlung und Statistik des Gebaermutter Krebses. *Zentralbl. f. Gynaek.*, 1915, xxxix, 627.

Ranshoff, J. L. Radium in the treatment of cancer of the uterus. *Lancet-Clin.*, 1915, lxxiv, 289.

Sampson, John A. Results of the radical abdominal operation for cancer of the uterine cervix. *Surg., Gynec. & Obst.*, 1913, xvi, 304.

Schauta. *Monatschr. f. Geburtsh. u. Gynaek.*, 1912, xxxvi.

Idem. Radium and Mesothorium bei Carcinoma cervicis. *Monatschr. f. Geburtsh u. Gynaek.*, 1913, xxxviii, 503.

Scherer, A., and Keley, B. Ueber die Behandlung des Uterus Krebses mit Roentgen and Radiumstrahlen. *Versamml. deutsche Naturforsch. f. Aerzte*, Wien, 1913.

Schindler, O. Erfahrungen ueber Radium and Mesothoriumtherapie maligner Tumoren. *Wien. klin. Wchnschr.*, 1913, xxvi, 1413, 1463.

Schmitz, H. An additional contribution to the therapeutic value of radium in pelvic cancer. *Surg., Gynec. & Obst.*, 1916, xxiii, 191.

Idem. The action of radium on cancer of the pelvic organs; a clinical and histological study. *J. Am. M. Ass.*, 1915, lxv, 1879.

Schottlaender and Kermauner. Zur Kenntniss des Uterus Karzinoms. Berlin: S. Karger, 1912.

Seuffert, E. von. L'etat actuel, les problemes et les limites du traitement radio et radium therapeutique du cancer. *Arch. d'electricite med.*, 1914, xxii, 552-571, 610-625.

St. Clair, R. Radium treatment of malignant tumors. *West M. Times*, 1915, xxxv, 89.

Tate, W. Discussion—Roentgen and radium therapy in gynecology. *XXVII Internat. Cong. Med.*, Lond., 1913, viii (2) 199.

Taussig, Fred. The prognosis for radical abdominal operation for uterine cancer. *Surg., Gynec. & Obst.*, 1912, xv, 147.

Taylor, Howard. Operation for carcinoma of the cervix uteri. *Surg., Gynec. & Obst.*, 1912, xv, 141.

Thaler. Zur erweiterten vaginalen Karzin zu Operation. *Zentralbl. f. Gynaek.*, 1915, xxxiv, No. 41.

Turner, Dawson. Report on the radium treatment at the Royal Infirmary, Edinburgh, during the year 1915.

Weckowski. Radium in Cancer. *Berl. klin. Wchnschr.*, li, No. 31, 1453.

Weibel, William. Extended abdominal radical operation for cancer of the uterus. *Surg., Gynec. & Obst.*, 1913, xvi, 3, 251.

Idem. Die klinische Stellung des Carcinoma corporis uteri. *Arch. f. Gynaek.*, 1913, c, 153.

Weinbrenner, C. Die Behandlung der Genital-carcinoma mit Mesothorium. *Monatschr. f. Geburtsh. u. Gynaek.*, 1914, xxxix, 181.

Wertheim. Radium Behandlung des Gebaermutterkrebses. *Wein. klin. Wchnschr.*, 1913, xxvi, 1648.

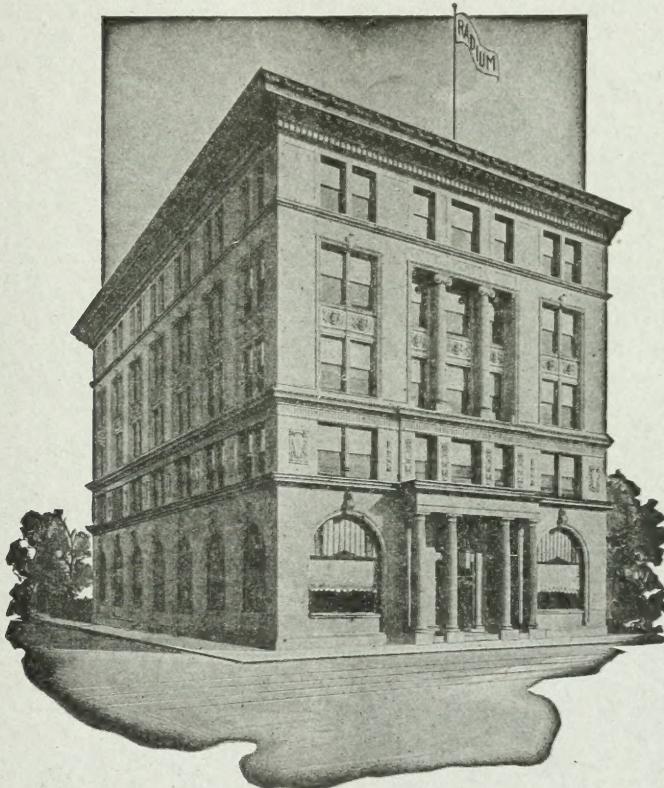
Idem. *Internat. Cong. Med.*, Lond., 1913.

Wickham, L., and Degrais, P. Radium therapie, cancer de l'uterus. Paris: 1912, 2nd ed.

Wilson. The results of abdominal operative treatment of cancer of the uterus. *Med. Press & Circular*, 1914, xcix, 302.

# STANDARD CHEMICAL COMPANY

PITTSBURGH, PA.



*General Offices and Radium Research Laboratory,  
Standard Chemical Company, Pittsburgh, Pa.*

Miners of Uranium and Vanadium Ores,  
and Producers of Radium

STANDARD CHEMICAL COMPANY

# RADIUM

STANDARD CHEMICAL CO.

---

Complete installations of latest apparatus for the collection, purification, tubing and measurement of Radium Emanation.

Departments of Physics and Medicine for instruction in physics of Radium, the technic of preparing Radium Emanation tubes and the therapeutic application of Radium and Radium Emanation.

Radium preparations sold on the basis of measurement by the United States Bureau of Standards.

Information as to equipment, technic and dosage upon request.

---

## RADIUM CHEMICAL COMPANY

GENERAL OFFICES AND LABORATORIES

Pittsburgh, Pa.

New York  
501 Fifth Avenue.

Boston  
Little Building.

Chicago  
Marshall Field Annex Building.

London  
Watson & Sons, (Electro-Medical) Ltd.  
43 Parker Street, Kingsway, W. C. 2.